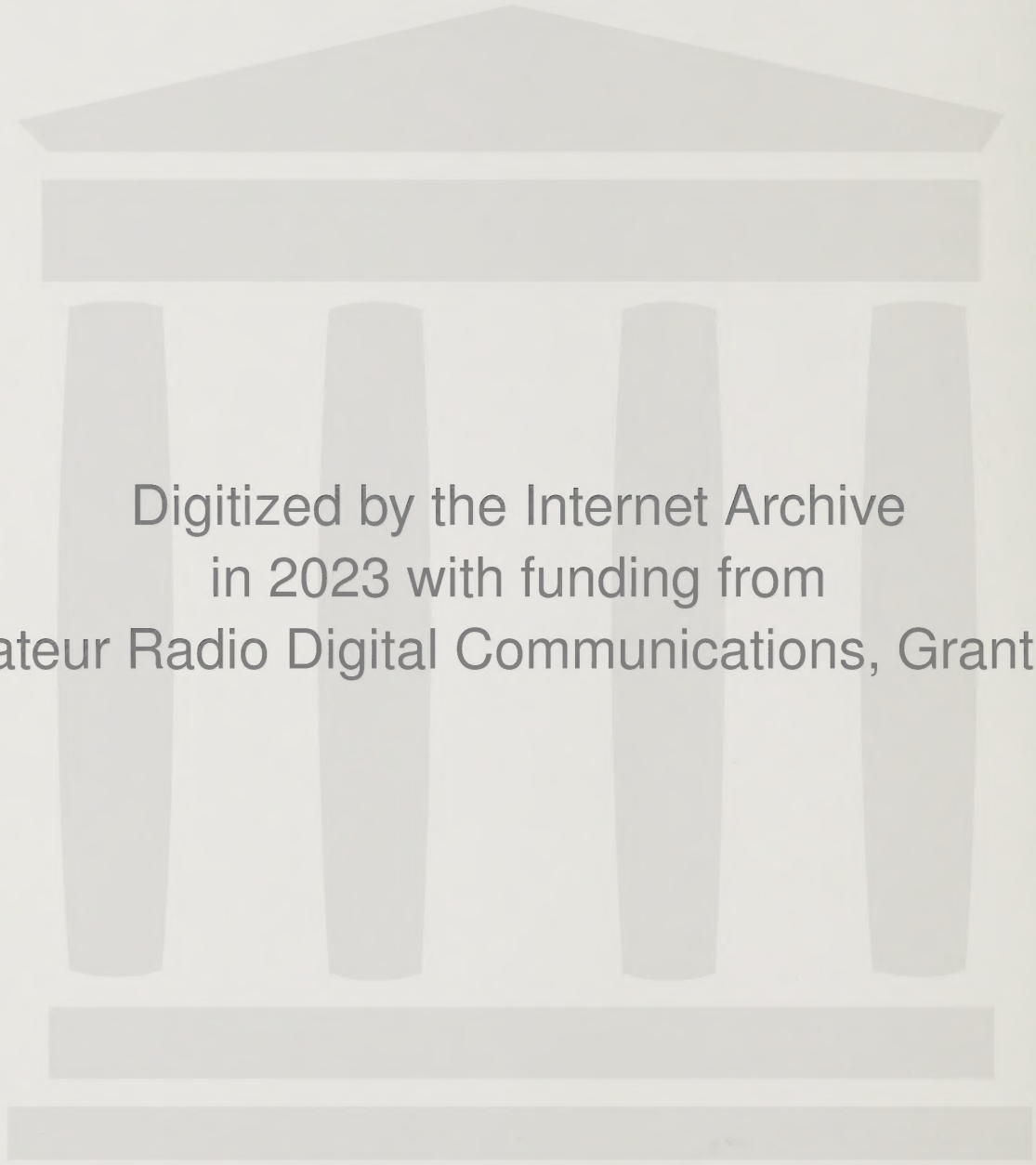
ATWATER KENT
RADIO
SERVICE MANUAL

ATWATER KENT MANUFACTURING COMPANY
4700 WISSAHICKON AVENUE, PHILADELPHIA



ATWATER KENT
RADIO
SERVICE MANUAL

The following pages have been prepared with the idea of enabling the Atwater Kent Radio Dealer to more thoroughly understand the product he is engaged in merchandising, and to more readily locate and correct any condition which might interfere with the proper functioning thereof.

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Table of Contents

rm No. Ser. D. 27.

INTRODUCTION

1. Purpose of Service Manual

The object of the Service Manual is to assist the retailer of Atwater Kent radio products in giving prompt and efficient service to the consumer-owner. Since in accordance with our Radio Service Policy, service on Atwater Kent radio products is to be handled by Atwater Kent dealers and distributors only, this publication should be considered confidential and except in special cases, is furnished only to regularly appointed outlets of Atwater Kent radio merchandise.

2. Importance of Service

Service has "come into its own" during the past few years and its importance is continually becoming more widely recognized. The value of prompt and courteous service by the dealer cannot be over-emphasized. Service is closely linked with sales—in fact the one depends on the other. The radio dealer who has foresight will build for the future by maintaining a neat and efficient repair department and employing a competent service personnel consistent with the size of his organization. There is no better step toward building good-will for Atwater Kent products in his immediate locality.

3. Dealer Service Procedure

The dealer who has a reasonably well equipped service shop will find that he is in a position to handle the servicing of practically any set which comes to him for repair, since the bulk of repairs will not be of a difficult nature.

In the event that he is unable to perform a certain repair, the set or unit should be returned to his local distributor, who maintains a complete service department similar to that of the factory. The distributor will furnish his dealers with complete instructions for return of material, such as making out of return report blanks and other routine in connection with the handling of service matters.

4. Dealer's Parts Stock

We strongly urge that every dealer carry in stock a supply of such repair parts as may be most commonly required for the more popular types of Atwater Kent sets and speakers. This will eliminate the possibility of a dissatisfied customer, resulting from the delay necessarily involved in ordering a part from the distributor.

Newly appointed dealers should consult their distributor regarding a suitable initial stock to be carried.

Repair parts must be purchased from the distributor. No parts are sold direct from factory to dealer.

5. Repair Charges—Warranty Repairs

The charge on a repair job for the consumer, on a set beyond the warranty, may be based on the consumer price of the repair parts used, plus a charge for the time required, at a definite rate per hour. The time charge will cover the time consumed in testing the set when repaired, and in calling for and delivering the set, if this is done.

Our factory warranty on new products, involves the replacement of parts defective in workmanship or material, and covers a reasonable length of time. Our distributors are notified by bulletin when certain models pass beyond the warranty period, so that in case of doubt, definite information can always be obtained from the distributor, as to whether a warranty adjustment is in order on a certain model.

In many cases the dealer will find it of advantage to adopt a written "Service Agreement" with the consumer, whereby a charge is made for service calls and repair work after a certain length of time. This will protect both dealer and consumer.

6. Service Policy

A complete printed "Service Policy," definitely outlining the factory's plan on service matters, is sent once a year to our distributors, and such information from this as is required by the dealer will be passed on to him by the distributor. A definite understanding between dealer and distributor on all matters pertaining to service will be the means of preventing much conflict and controversy. It cannot be too strongly urged that all instructions from the distributor be carefully followed, so that complete co-operation will exist. Written instructions, such as bulletins, etc., should be kept handy in a loose-leaf note book.

7. Service Literature

The dealer will do well to keep readily available, ALL literature pertaining to service which comes into his place of business. In addition to the bulletins from your distributor, the factory has a special "Dealer Bulletin Service" which contains various suggestions and ideas along service lines.

There are several excellent monthly radio trade publications which are invaluable to the retail dealer, both from a sales and service standpoint. We believe the small price of annual subscription to several of these magazines will be more than repaid by the excellent information and ideas they contain.

Two or three good text books on radio will also not be out of place on the dealer's book shelf. An easily understandable book on the theory of radio and a practical book on general radio service and repairing are suggested.

8. Factory Service Course

One of the best ways in which the recognized Atwater Kent dealer (or his service man) can familiarize himself more completely with the correct methods of servicing Atwater Kent radio products, is to spend a week or two in our factory Service Department. We have mapped out a "Course" of training to be followed in this work, which completely covers the various steps in repairing, assembling, and testing all models of our Sets, Speakers, and Power Units.

The "Service Course" takes from one to three weeks depending on the ability of the individual. There is no charge for the instructions, but the dealer will naturally furnish the transportation and living expenses connected with this visit to Philadelphia. A letter of introduction from the local distributor is required and must be presented at the factory for identification purposes.

SECTION I

THEORY OF RADIO BROADCAST RECEIVERS

nowledge of Theory Essential

While the primary purpose of the Service Manual is instruct the dealer in the testing and epairing of twater Kent receiving sets, **we believe that an under-inding of the fundamental principles of radio and a owledge of how our sets function will enable him to rform this work more intelligently.** It is, of course, sential to know what to do to correct troubles, but a owledge of the theory and functioning of the various its of the set will enable the repairman to locate the ouble more readily. If an unusual condition arises in set, a repairman without a knowledge of the principles volved, can correct the trouble by "hit-or-miss" ethods only. The service man who has this funda-ental knowledge can analyze the condition and then termine the remedy.

undamental Principles of Electricity Applied to Radio

Radio is based on electricity and a few of the ele-entary conceptions of its fundamental principles should understood before going further. Electricity shows any characteristics of a fluid such as water, but unlike ater, it apparently has no substance, and its presence n be determined only by the effect. Its force, quantity id other properties, however, can be determined and easured by electrical instruments.

In the pipe line shown in Fig. 1, there is a complete rcuit of water which is flowing through the pipes as a sult of the force exerted by the pump. The left-hand etch is a diagram of an electrical circuit in which the ectricity is flowing as a result of the force exerted by e batteries. There is a definite amount of water flow-g in the pipe line and there is likewise a definite mount of electricity flowing in the electrical circuit.

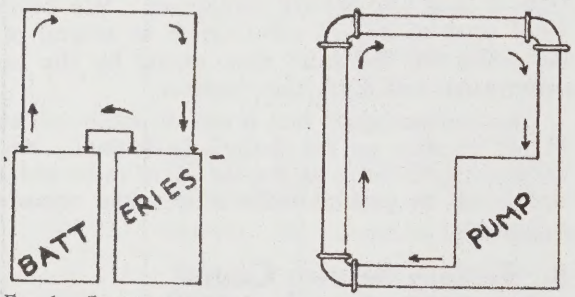


FIG. 1. COMPARISON OF ELECTRIC CURRENT WITH WATER.

The quantity of electricity flowing is measured in units lled amperes.

The water has a certain pressure forcing it through e circuit. The electrical circuit likewise has a definite essure, which is measured in units called volts. In the ater circuit there is a certain amount of resistance due the friction offered to the water by the sides of the pe. This resistance is obviously greater in a small pipe an in a large one. The electrical circuit likewise has a sistance depending upon the gauge of the wire, its length and the material of which it is made. Electrical resistance is measured in units called ohms.

In the diagram shown in Fig. 1, the water and electricity flow in one direction only. This type of electrical current and all currents produced by batteries is known as direct current.

Alternating Current

Alternating current may be compared to the sort of water flow illustrated in Fig. 2. Instead of being forced continuously in one direction by a pump, it is pushed first in one direction and then the other by the piston "P." If the rate at which the piston moves back and forth is constant, it corresponds to the frequency of an alternating current, which is generally expressed in "cycles" per second.

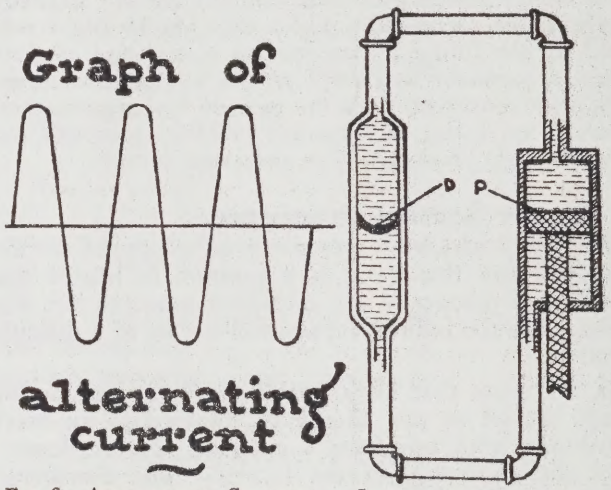


FIG. 2. ALTERNATING CURRENT IS SIMILAR TO ALTERNATING WATER FLOW.

The diagram (Fig 2) is a graphical representation of alternating current. The current is built up to a certain voltage in one direction, falls back to zero voltage, builds up an equal voltage in the other direction, and again returns to zero. The two directions are known as positive and negative, and alternating current consists of a series of such alternations in direction, expressed in cycles per second. In the case of "radio" frequency currents, these alternations are very rapid, the frequency ranging approximately from 500,000 to 1,500,000 cycles per second.

Condensers

The action of the flexible diaphragm "D" illustrates the action of a fixed condenser in a circuit of alternating current. The diaphragm would stop a direct flow of water, but allows it to surge back and forth. A condenser likewise acts as an insulator to a circuit of direct current, but not to a circuit of alternating current of high frequency. It will be seen later how this property of a fixed condenser is used in our receiving sets.

A condenser is fundamentally a unit for storing electricity, and its ability to do this is termed capacity, expressed in units called farads. This is a very large unit, however, and the practical unit of capacity is the micro-farad which is one millionth of a farad.

A fixed condenser (one of constant capacity) consists of two or more parallel metallic plates, which are separated from each other by mica, air or another insulator. The capacity of a condenser depends upon the number and size of the metal plates, the distance between them and the insulating material. In the case of our by-pass condenser, which must have a comparatively large capacity, the metallic portion consists of two layers of thin, pure tinfoil, separated by special impregnated linen tissue. The system of layers is then wrapped as shown in Fig. 3. A condenser made with mica insulators, having the capacity of this by-pass condenser, would be very impractical because it would necessarily be very large.

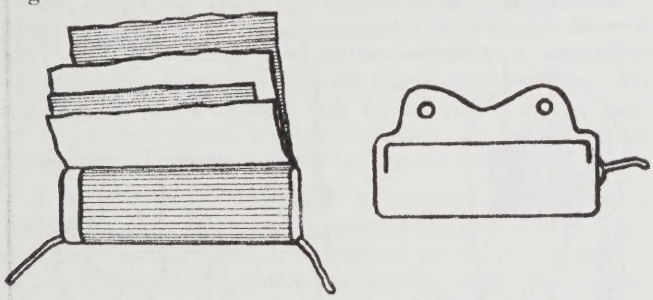


FIG. 3. CONSTRUCTION OF TYPICAL FIXED CONDENSER.

A variable condenser (Fig. 4) is so called because the capacity can be varied. This is accomplished by having two sets of metal plates interleaved with each other and one set revolving on a shaft so that any desired area of the plates can be interleaved. By turning the shaft and revolving one set of plates, the capacity of the condenser is changed to any desired amount within the limits of its total capacity.

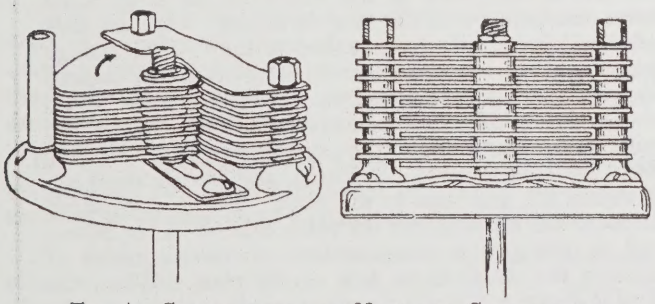


FIG. 4. CONSTRUCTION OF VARIABLE CONDENSER.

Transformers

Transformers are a very important part of a receiving set and when used in connection with a radio tube, serve as a method of amplifying the broadcast signal after it has been picked up. The theory briefly is this: A coil of wire which has an alternating, intermittent, or pulsating current passing through it, sets up a constantly changing electro-magnetic field (lines of force having both electric and magnetic properties). (See Fig. 5.) If another coil of wire is placed in this electro-magnetic field, a current will arise in and flow through this second coil, even though there is no physical connection to the first. This transfer of electric energy takes place by what is called "induction." The voltage "induced" in the second

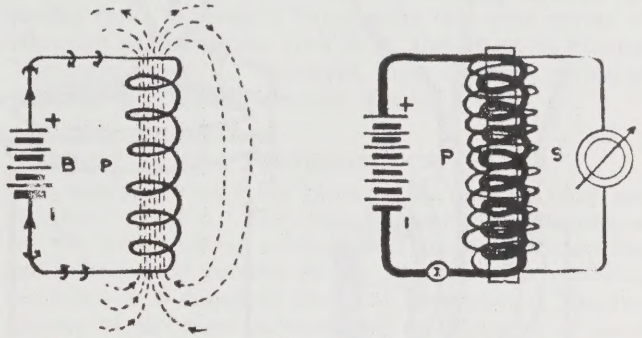


FIG. 5. ELECTROMAGNETIC INDUCTION—ACTION OF A TRANSFORMER.

coil may be made considerably greater than that in the first coil by having a greater number of turns of wire in the second. For ordinary alternating and intermittent current, the two coils of wire (which are called primary and secondary) are wound around a soft iron core, which greatly strengthens the electro-magnetic field and increases the efficiency of the transformer. The two windings are insulated from each other and also from the core.

Audio Frequency Transformers

Our audio transformer No. 7661 (See Fig. 6) consists of a soft iron core made of a number of soft iron wires, a primary winding of about 6,000 turns of wire and a secondary of 15,000 turns of wire (gauge 40). The ratio of the number of turns of secondary to primary is 2.5 to 1, which is likewise the ratio of output to input. The first stage transformer (No. 8060) has a ration of about 4 to 1. (Fig. 7).

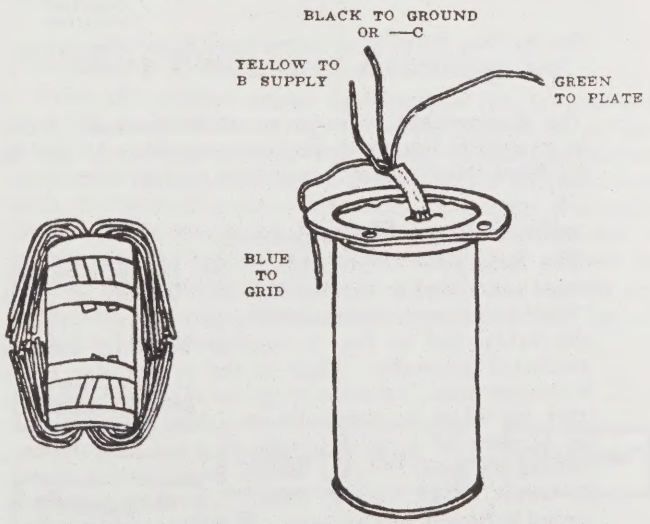


FIG. 6. AN ATWATER KENT AUDIO FREQUENCY TRANSFORMER (2d stage).

The iron core of a transformer builds up an electro-magnetic field which varies the same as the current in the windings. However, an iron core cannot respond efficiently to currents which vary at a rate of over 500,000 cycles per second, which is the case of radio frequency current, and radio frequency transformers are,

ıerefore, usually made without a solid core, and are ɛrmed "air-core" R. F. transformers.

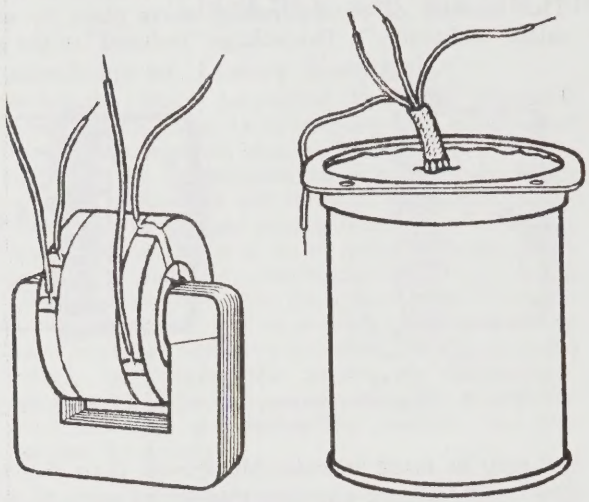


FIG. 7. ANOTHER TYPE OF ATWATER KENT AUDIO TRANSFORMER (1st stage).

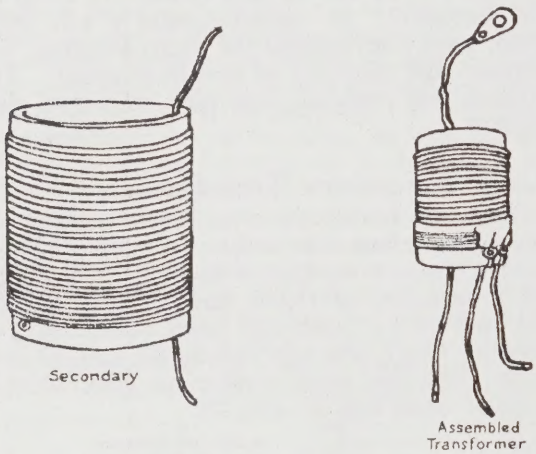


FIG. 8. TWO TYPES OF ATWATER KENT RADIO FREQUENCY TRANSFORMERS.

Fig. 8 shows the types of transformers used in our ts to amplify the radio frequency signals. As can be en, these transformers do not have an iron core.

.adio Tubes—Construction

The radio tube is undoubtedly one of the most im-ɔrtant units used in radio reception. We are all more ' less familiar with the external appearance of common dio tubes, and in Fig. 9, we see how the tube is ɔnstructed internally. Most of the present-day tubes ɛ vacuum tubes, but some of special type are filled with rare gas which is chemically and electrically inactive. he filament of a vacuum tube is made of tungsten, ıoriated tungsten or other metals coated with a chemi-l, which, when heated, emits electrons (negatively ıarged particles) in a vacuum. Tungsten, when it con-ins thorium, emits a greater number of electrons at a ven temperature than plain tungsten, and consequently ɛquires less current. The plate is made of thin metal,

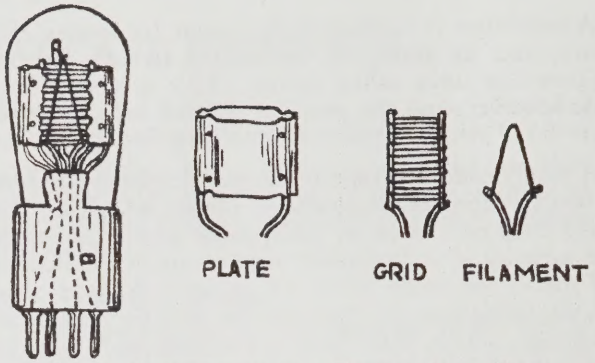


FIG. 9. CONSTRUCTION OF A TYPICAL RADIO TUBE.

stamped in the form shown in the illustration. The grid is of fine wire, so placed that it forms a sort of lattice work between the filament and the plate.

Internal Action of the Tube

The diagram on the right (Fig. 10) is a schematic symbol representing a vacuum tube. The diagram on

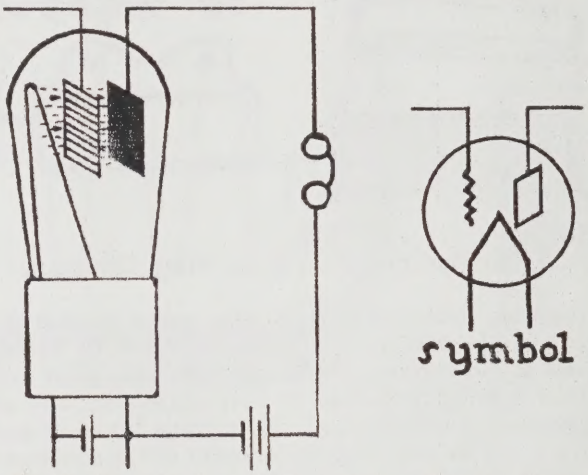


FIG 10. PATH OF FLOW OF ELECTRONS IN VACUUM TUBE.

the left is also more or less schematic, so as to show more clearly just how the tube functions. The two ends of the filament wire are attached to the "A" or storage battery, which heats the wire so as to create the desired amount of electronic emission. These electrons would ordinarily fly off in all directions, but the plate of the tube being connected to the positive side of a "B" battery, has a high positive potential, and the electrons are attracted by, and flow to the plate. The grid is placed between the filament and the plate, and when the potential on the grid is comparatively positive it assists in causing the electrons to flow to the plate. When the grid is negative it repels the electrons on their way to the plate and when sufficiently negative, may stop the flow.

The negative side of the "B" batteries is connected to the filament and as mentioned before, the positive side is connected to the plate. In the particular illustration shown there is also a 'phone unit placed in the circuit. When a stream of electrons flows between the filament and plate, the "B" battery circuit is completed across this gap and a current passes through the 'phone unit. However, as previously stated, the potential on the grid

determines the intensity of the electron stream between the filament and plate, consequently as the potential on the grid varies, the current in the plate circuit and therefore in the 'phone unit also varies. The incoming broadcast signal is the factor which causes the potential of the grid to vary. Thus the current in the broadcast transmitter, varied by a voice or sound in a microphone at the broadcasting station and radiated in the form of high frequency alternating current, eventually controls the current which flows through the speaker unit at the receiving set and similar sounds are consequently reproduced. As a small voltage impressed on the grid controls a large current in the plate circuit, the tube may be used as a means of amplifying radio signals.

Action of Tube as Detector

The radio frequency currents which pass into the set from the antenna are of extremely high frequency, between 500,000 and 1,500,000 cycles per second. If a speaker unit were installed directly in this circuit with the current varying with such rapidity, it would be mechanically impossible for the diaphragm to respond to the variations in current. If it did respond, the pitch of the sound waves created would be so high that the sound would not be audible to the human ear.

It is, therefore, necessary to convert the radio frequency current to an audio frequency current which will operate a speaker unit and produce sound waves audible to the human ear. This is accomplished by the detector tube, which through the action of the grid condenser and grid leak, rectifies the radio frequency current. The potential on the grid of this tube is affected not only by the alternations of the radio frequency signal, but also by the charge which is stored up by the grid condenser. The current produced in the plate circuit of this tube has the same characteristics as the radio frequency current, but at a lower frequency.

Principles of Radio Wave Transmission

Some of the fundamentals of electricity and the units used in a radio set have now been discussed, and the question that arises in the minds of many is, "How does the radio frequency current generated by the broadcasting station reach the receiving set?"

Electrical energy in the form of a radio frequency wave which has been modulated by a voice or music, is radiated in all directions by the broadcasting antenna.

An analogous mechanical phenomenon will illustrate what takes place. When a tuning fork is made to vibrate, waves are sent out and any tuning fork within range having the same period of vibration will be affected and start to vibrate also. The tuning fork "A" (Fig. 11) is caused to vibrate by striking it, and the tuning fork "B," which has exactly the same period of vibration as the tuning fork "A," also starts to vibrate. The tuning fork "C," however, has a different period of vibration and is therefore not affected.

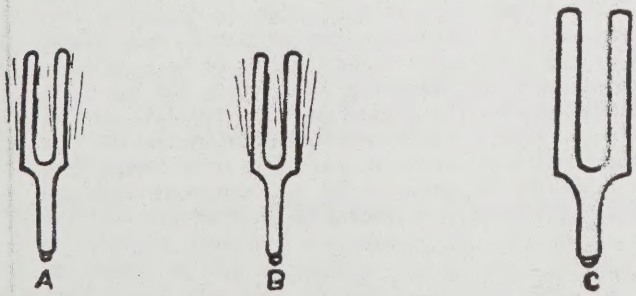


FIG. 11. TRANSFER OF MECHANICAL VIBRATIONS BETWEEN UNITS HAVING SAME FREQUENCY OF VIBRATION.

Purpose of the Antenna

A similar action takes place in the broadcasting and reception of radio. The radio frequency wave radiated by the broadcasting antenna sets up a corresponding radio frequency current in the antenna of a receiving set when it is tuned to the same frequency. The frequency of the wave is expressed in kilocycles or wave length, and since the tuning devices in the receiving set enable us to change the period of vibration or frequency of the set, we are able to receive waves from any broadcasting station within range. The radio frequency current in the broadcasting antenna is of such high frequency that a wave of electrical energy is radiated from it, and if the receiving antenna has the same period of vibration, it responds to this wave in such a way that a radio frequency current is set up in the antenna circuit. The purpose of the receiving antenna is therefore to convert the waves of electrical energy that are in the air to radio frequency current in the receiving set.

The alternating currents set up in the antenna circuit are of extremely high frequency, ranging between 500,000 and 1,500,000 cycles per second. As mentioned before, it is impossible to convert alternating current of such high frequency directly into sound waves, and it is therefore necessary to convert this current to a pulsating current of audio frequency. We have already explained how this is accomplished by the action of the detector tube.

Necessary Elements of Receiving Set

From the various points discussed so far, we can see that the simplest receiving set would consist of an antenna, to convert the electrical energy to radio frequency current; a tuning device, to bring the set to resonance with the desired wave; a detector, to convert the radio frequency current to an audio frequency current; and a 'phone unit to convert the audio frequency current to sound. It is highly desirable to amplify the signals received so that the sound waves produced will be of considerable strength.

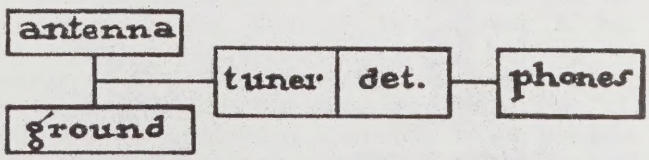


FIG. 12. FUNDAMENTAL UNITS OF A RECEIVING SET.

Circuit and Construction of Model 20 Compact Set

The Model 20 Compact three-dial receiving set has two stages of radio frequency amplification, a detector and two stages of audio frequency amplification. In

plaining what takes place in each stage, schematic agrams will be referred to using the symbols shown Fig. 13.

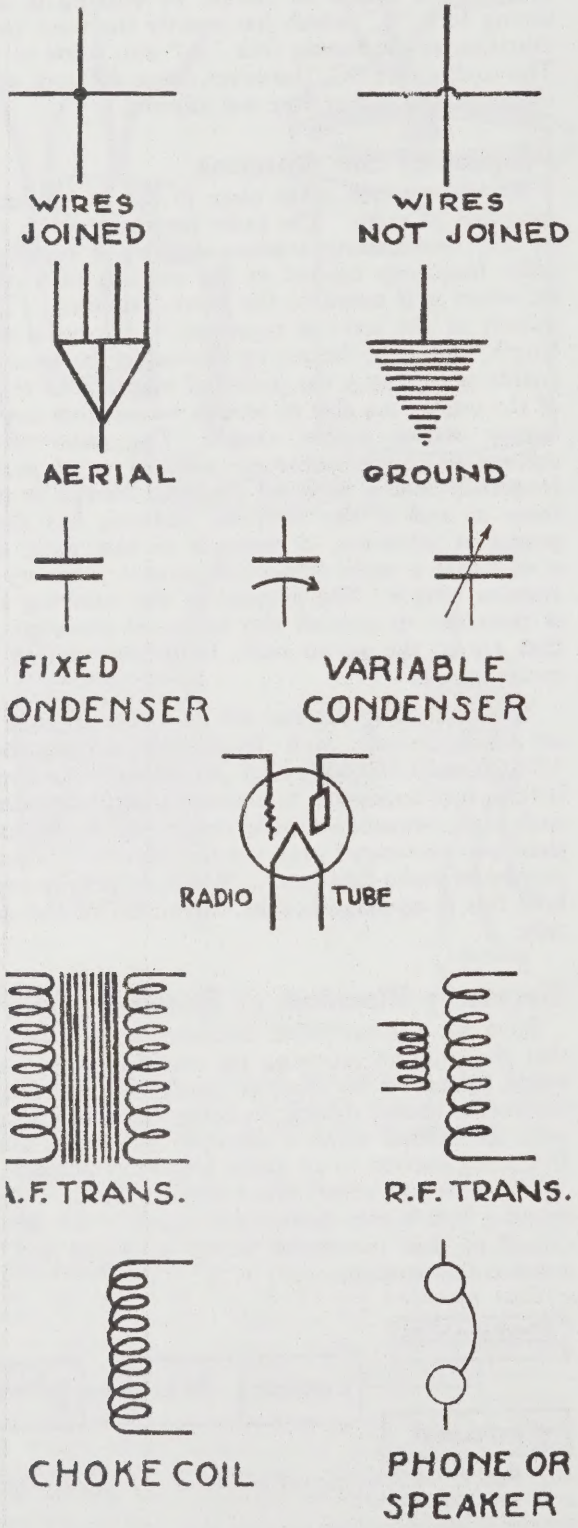
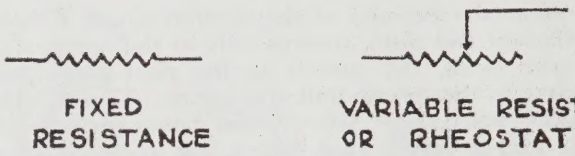


Fig. 13. Symbols Used in Schematic Radio Diagrams.



Referring to Fig. 14, the antenna circuit, which consists of aerial, primary of the first radio frequency transformer and ground, converts the waves of electrical energy in the air to radio frequency current. The aerial wire and the primary winding of the transformer give this circuit a certain amount of inductance. In general, and up to a certain limit, a long aerial and considerable inductance in the coil winding will pick up the greatest amount of energy. Too much inductance, however, lessens the selectivity and since it is impractical to shorten or lengthen the aerial wire to regulate this, we change the number of turns in the primary winding of the first coil by means of the tapped switch and thus accomplish the same thing. Placing the switch blade on the first tap (Fig. 14), puts fewer turns of wire in the circuit and increases the selectivity at a slight sacrifice in volume. Using the third tap, which uses all the turns of wire of the primary winding, increases the volume considerably, at a sacrifice of selectivity. The center tap is a medium between the first and third.

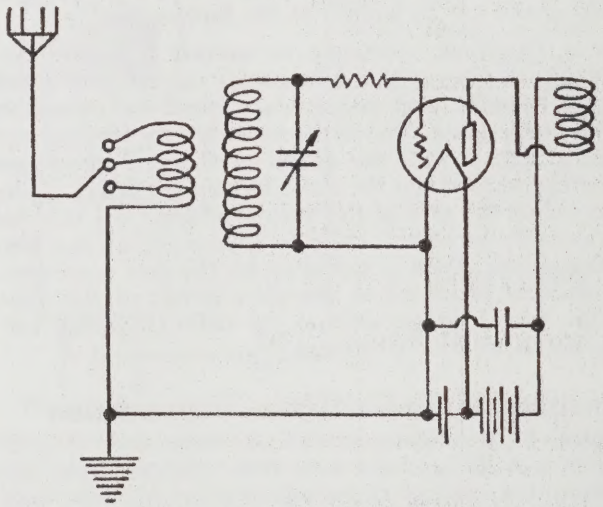


Fig. 14. Antenna Circuit and First Stage of R. F. Amplification—Model 20 Compact.

Detector Circuit—Action of Grid Leak and Condenser

After passing through the three radio frequency circuits, the signal which is still a radio frequency current as it was originally set up in the antenna circuit, but considerably amplified by the R. F. transformers, is impressed upon the grid of the detector tube (Fig. 15). The function of this tube as explained under tube action, is to rectify the radio frequency current to a pulsating current of audio frequency, and which has the same characteristics as the original current. This tube may be the same type as those used for amplifiers and the fact that it rectifies the current, instead of merely amplifying it, is due to the action of the grid condenser and grid leak. The grid condenser collects a charge and the

accumulated charge is impressed upon the grid of the tube. The grid leak prevents this charge from becoming too great by allowing it to leak off slowly to the filament circuit.

The grid leak is connected to either the positive or negative filament circuit, but experiments by our laboratory have shown that the detector circuit offers least resistance to weak signals when the grid leak is connected to a slightly negative potential. To accomplish this, a fixed resistance of about 450 ohms is installed directly across the positive and negative filament circuit, and the grid leak is connected to the two-fifths point, nearest the negative side.

The radio frequency current impressed on the grid of the detector tube is, by the above process, rectified to an audio frequency current in the plate circuit of this tube,

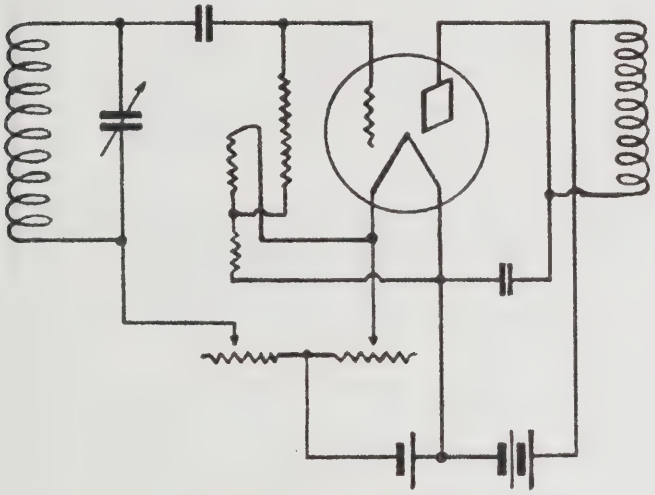


Fig. 15. Detector Circuit.

and if a 'phone unit were connected in series with this circuit, the broadcast signal would be converted to sound. However, for purposes of loud-speaker reproduction, it is desirable to amplify this signal to greater strength, and accordingly the primary winding of an audio frequency transformer is placed in this circuit instead. This plate circuit is completed through the "B" battery to the filament circuit.

Purpose of "'Phone Condenser"

There is a small component of radio frequency current which is passed to the plate circuit of the detector tube from the grid circuit. If this current were allowed to pass through the "B" batteries and audio transformer with the audio frequency current, it would cause some distortion. A small fixed condenser called a 'phone condenser is therefore connected between the plate and the filament of the detector, which shunts this radio frequency current across the audio transformer and "B" batteries. No direct current from the batteries and none of the audio frequency current can go through this condenser.

Action of Audio Frequency Transformers

The pulsating current in the primary circuit is induced and amplified in the secondary circuit and is again impressed upon the grid of the next tube (Fig 16). It is amplified to the plate circuit of this tube, in which circuit is placed the primary of the second audio frequency transformer. The signal is then induced and amplified in the secondary of this transformer and is again sent into the grid circuit of the next and last tube. The sound unit of the radio speaker is installed in the

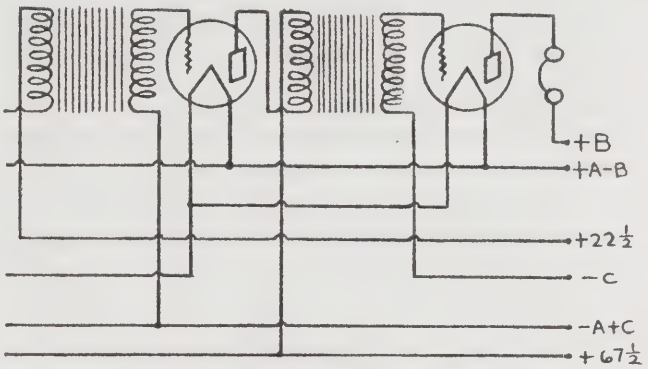


Fig. 16. Audio Frequency Circuit.

output or plate circuit of this second audio frequency amplifier tube, and the variations in current cause the diaphragm to vibrate and send out sound waves which have the same characteristics as the wave of the pulsating current sent through the sound unit. The characteristics of this electrical current were determined by the sounds sent into the microphone at the broadcasting station. The theory and construction of speaker units is described in Section X of this Manual.

Use of "C" Battery

One lead from the secondary of the first audio transformer is connected to the grid of the following tube and the other lead, called the grid return, is connected to the filament of the same tube. The grid return of the second audio transformer, however, is connected to the filament of the last tube through a "C" battery, this grid return being connected to the negative side of the battery. As explained under tube action, the potential on the grid of the tube determines the flow of "B" battery current across the plate and filament, the flow being less when the grid is comparatively negative. By placing a negative potential supplied by the "C" battery on the grid, considerable "B" battery current is saved, and amplification without distortion obtained.

Power Tubes

Power tubes are tubes especially designed to handle the considerable volume of signal reaching the last stage of audio amplification and at the same time give improved tone quality. They require additional "B" battery voltage on the plate, and also a fairly high negative voltage on the grid, to prevent the tube from becoming overloaded, which would cause distortion. The "C" battery is connected so as to operate on the last tube only, so that the desired negative voltage may be used on the grid of this tube without affecting the first audio tube, which would not function properly if used with the negative grid voltage required by a power tube.

Grid Resistances and By-pass Condenser

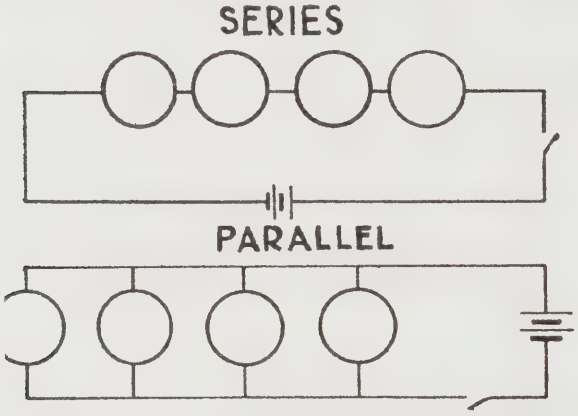
Two units which have not as yet been discussed and which are essential to the operation of the set are the

id resistance unit and by-pass condenser. A grid resistance is connected in the grid circuit of each of the dio frequency amplifier tubes and is one of the means ed to keep these tubes stabilized.

The by-pass condenser is shunted across the "B" wer supply of the radio frequency tubes and allows e plate circuits of these tubes to be completed directly the negative filament circuit. This likewise assists stabilizing the set and preventing distortion.

ilament Connection of Tubes

There are two fundamental methods of connecting veral electrical units in the same circuit, namely series d parallel (see Fig. 17). Each method has its own rticular advantages and is used accordingly. In the se of a parallel connection of units, each unit can ceive the voltage of the source of current and can be erated and controlled independently of the others. r this reason the tubes in our sets, in fact in most dio sets, are connected in parallel (see Fig. 19).



G. 17. The Two Fundamental Methods of Connecting Several Electrical Units Together.

rrangement of Rheostats

A variable resistance, or rheostat, is connected in series ith one of the main filament battery leads to the radio equency tubes, which permits the control of the filament current supplied to these tubes independently of e other tubes. Another rheostat is connected in series ith the detector tube to control it separately.

The audio frequency tubes require a definite voltage operate at maximum volume. A lower voltage will duce the volume, but while this is sometimes desirable, it also impairs the tone quality. A higher voltage does not improve the tone or the volume and our sets are therefore equipped with a fixed resistance rather than a rheostat for these audio tubes. The volume of the set is readily controlled by the radio frequency rheostat.

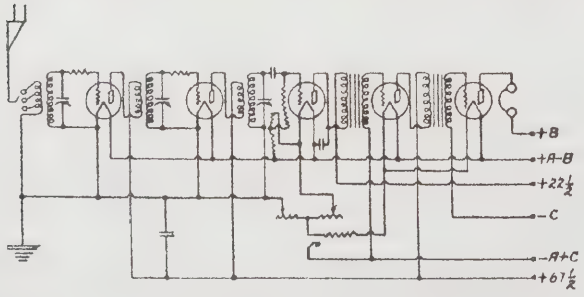


Fig. 18. Schematic Wiring Diagram of Model 20 Compact Set.

Plate Voltage on Different Tubes

The plate of each tube is connected through the primary of the transformer following it, to the positive side of the "B" batteries. Tubes functioning in different circuits of the set required different plate voltages and the plates are therefore connected to different terminals of the source of "B" voltage (batteries or "B" power unit). The plates of the radio frequency tubes and the first audio tube are connected to positive 67½ volts, the detector to 22½ volts, and the last audio tube to plus 90 or a higher voltage, according to the type of tube used.

Model 30—Circuit and Operation

The general circuit of the Model 30 set (Fig 19) is very similar to that of the Model 20 Compact No. 7960,

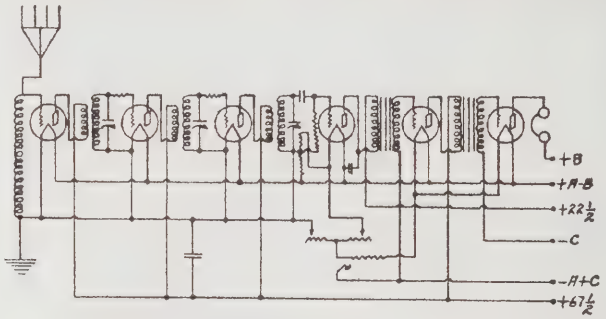


Fig. 19. Schematic Wiring Diagram of Model 30 Set.

but being operated by one dial, certain additions are necessary. The radio frequency transformers are substantially the same as those in the three-dial sets and have approximately the same inductance. However, these transformers are not taken indiscriminately and installed on sets, but each set of coils is selected after their inductances and other characteristics have been determined by special apparatus. A set of variable condensers is likewise carefully selected to be used with these transformers.

"Synchronizing" the Condensers

The variable condensers are controlled simultaneously by having the rotor shafts driven by belts, which are connected to a common pulley, which is turned by the single or center dial (Fig. 20). As the dial is turned, the capacities of the three variable condensers are changed uniformly, and the respective circuits which they tune are all brought into resonance with the same frequency of current. Because these condensers and transformers have all been accurately matched, this condition holds good over the entire wave length band.

Condensers, so adjusted that one movement will tune all their circuits, are termed "synchronized." The method used in the Atwater Kent single-dial sets is licensed under Hogan Patent Number 1014002.

On the three-dial sets it was observed that as the condensers were tuned for various wave-lengths, the dial settings of the three condensers were approximately the same. By the system of matching already explained, the slight difference in setting is overcome, and synchronism is established.

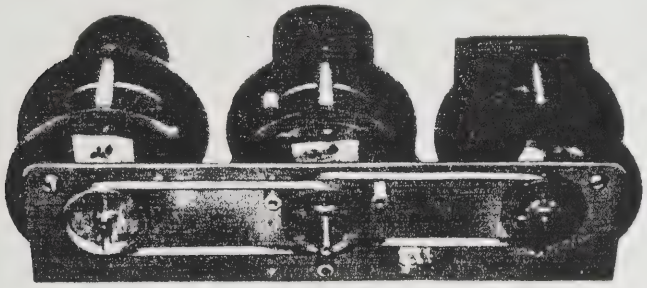


FIG. 20. METHOD OF CONNECTING VARIABLE CONDENSERS BY BELTS.

Eliminating the Antenna Tuning Device

It was also observed in the case of the three-dial receivers that the setting of the first dial varied according to the length of the aerial used, while the other two dial settings were unaffected. Since we cannot tune the aerial circuit independently in a one-dial receiver, we must overcome this condition in some other way. An additional tube, which is installed in the antenna circuit, takes care of this.

This tube has very little value in amplifying the signals, being used simply to transfer all signals from the antenna circuit to a position where any desired one can be selected and amplified to maximum by the synchronized tuning control before it reaches the detector. It also eliminates the effect of the antenna circuit on the tuning of the succeeding circuits by the dial.

Model 35

The Model 35 set is considerably different from the Model 30 in the mechanical design, which requires certain changes in the electrical design. The circuit, however, is identical with that of the Model 30, with the exception of the detector rheostat. (Fig. 21.) In the other sets, the radio frequency tubes are controlled by one rheostat, the detector tube by another, and the audio exception of the detector rheostat. (Fig. 21.) In the set, the radio frequency tubes are controlled by a rheostat, and the detector and audio frequency tubes are controlled by a fixed resistance.

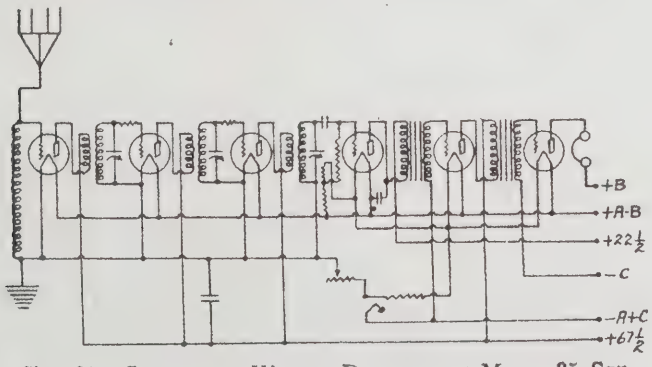


FIG. 21. SCHEMATIC WIRING DIAGRAM OF MODEL 35 SET.

Model 32

The Model 32 set has an additional stage of radio frequency amplification which necessitates a fundamental change in the type of radio frequency transformer used. In the Model 20, 30 and 35 sets, which have three radio frequency transformers, the transformers are mounted at right angles to each other, to prevent an electrical coupling between them. However, the Model 32 set has an additional radio frequency transformer, and since there are only three mutually perpendicular planes, we must use a different method to prevent a coupling between these transformers.

The circuit and functioning of this set is identical with that discussed for the Model 30, except for the additional stage of radio frequency amplification, which requires an additional transformer, tube socket and variable condenser. This stage of R. F. amplification increases the selectivity, sensitivity and volume of the set. The extra condenser is tuned by a third belt, also connected with the main or single control dial shaft. There are therefore three belts controlled by the tuning dial of the Model 32.

Model 33

The Model 33 set is a six-tube outfit, combining some features of both the Model 20 Compact and the Model 30 sets. It has three stages of radio frequency amplification, controlled by a single dial similar to the Model 30. However, instead of the untuned antenna circuit, an inductance or antenna coil is connected between the antenna and ground and provided with two taps connected to binding posts, so that part or all of the coil can be placed in the circuit, depending on the length of the antenna used. In addition to this, one of the rotary plates of the first variable condenser is controlled by a separate small knob at the left side of the panel, so that perfect resonance is obtainable in the antenna circuit regardless of the length of antenna. This set is therefore more selective than the Model 30, and easier to tune than the Model 20 Compact, at the same time being more efficient than either. A schematic diagram of the Model 33 will be found in Section VI of this Manual.

A.C. Type Receivers

During the summer of 1927 a new type of tube was developed, the outstanding characteristic of which was the fact that it was designed to operate with alternating current on the filament instead of direct. The producing of these tubes meant that it was possible to design a set to operate direct from the A. C. electric socket without batteries, since the only necessary step was to reduce the voltage of the A. C. line to the correct value for the tube filaments, which is easily accomplished by means of a "step-down" transformer. The B voltage requirements of these tubes being practically the same as those of the previous type D. C. tubes, the incorporation of a B power unit in the set along with the step-down transformer results in a completely light-socket-operated set.

The theory of function of the A. C. tubes is very similar to that of the D. C. tubes, and will not be discussed here. In general performance they compare very favorably with the D. C. tubes. The filament voltage requirements are slightly different, however, an A. C. voltage of 1½ being required for the amplifier tubes and 2½ volts for the detector tube. The power tube used is a regular D. C. type requiring the standard 5 volts, since by the use of a center-tapped resistance across its filament terminals, the effect of the A. C. fluctuations is effectively balanced out in this particular circuit.

The A. C. detector tube differs from the D. C. tubes in having an extra element known as the "cathode." This necessitates a five-prong socket for this tube. The cathode is a cylinder of special metal surrounding the filament, and performs the same function as the filament in a D. C. tube. The filament in the A. C. tube is used only to warm the cathode so it can function. Owing to the material and construction of the cathode, a period of about 30 seconds after the set is turned on, is required before it warms sufficiently to function and allow signals to come through the set.

Power Units In the A.C. Receivers

The power units used in Atwater Kent A. C. receiving sets furnish direct current "B" supply for the plate circuits, direct current "C" supply for the grid circuits, and alternating current of the proper values for the filaments of the A. C. tubes. Every power unit consists of the following essential parts:

(1) **A power transformer** to change the voltage of the 110 volt A. C. line to the required higher and lower values. This transformer has a primary, a high-voltage center-tapped secondary winding, a low voltage secondary winding for the filament supply of the rectifier tube, and three other low voltage secondary windings for the filament supply of the receiving tubes.

(2) **A double-wave filament-type rectifying tube** that converts the high voltage A. C. to pulsating D. C. The tube has two separate plate electrodes which are connected to opposite ends of the high-voltage winding. The center tap of this winding is connected to ground, which is equivalent to —B. When the outside circuit between the filament of the rectifying tube (equivalent to +B) and the center tap of the high voltage winding is completed through the filter and the plate circuits of the radio set, electrons flow from the filament to whichever plate is positive. As the rectifier plates are alternatively positive, electrons flow from the filament almost continually. This flow of electrons constitutes a steady flow of pulsating direct current.

(3) **A filter section** consisting of audio frequency chokes and high-capacity fixed condensers, serving to smooth out the pulsating direct current delivered by the rectifying tube and make it pure and noiseless in action.

(4) **Resistances** of the correct value to reduce the high rectified voltage to the values required by the first A. F. and detector plate circuits. By-pass condensers are connected to these resistances.

(5) **A grid bias resistance** connected between the ground and the second A. F. filament circuit, and another bias resistance connected between the ground and the R. F.—first A. F. filament circuit. The plate currents flow through these resistances and cause a voltage drop across them, the filament end of each resistance being positive with respect to the ground end. By connecting the grid return leads of the amplifying tubes to ground, the grids are maintained at a negative voltage with respect to the filaments.

(6) **Three separate "step-down" filament windings** or secondaries on the power transformer. These reduce the 110 volt A. C. supply to the voltages required by the filaments of the tubes, about 1½ volts for the R. F. and first A. F. filaments, 2½ volts for the detector filament, and about 5 volts for the second A. F. filament.

Connections between the filament circuits and the set are made to a center tap on resistances of low value shunted across each filament supply winding. The purpose of these center-tapped resistances is to provide a neutral voltage point which does not vary in value. The voltage on either side of the filaments is alternating (A. C.), and if the grid-return leads were connected to either side of the filament circuits, this A. C. voltage would be impressed on the grids of the tubes, causing a loud hum in reception. The center tap on each shunt filament resistance is like the pivotal or center point on a see-saw, it does not move up or down, but remains steady.

(7) **A speaker or output choke.** One end of this choke is connected to the rectified and filtered high voltage supply and the other end is connected (through the set cable) to the plate of the second A. F. tube. The choke offers but little resistance to direct current, but it has a high effective resistance or impedance to audio frequency variations, tending to make audio frequency variations of the plate current flow through the speaker, which is coupled to the plate of the second A. F. tube through a fixed condenser (the speaker filter condenser). The return lead from the speaker is connected to the center tap of the second A. F. filament shunt resistance. With this arrangement no direct current flows through the speaker, but only the audio frequency or A. C. component of the plate current.

(8) **A panel assembly** which contains the terminals for connection to the cable card of the receiving set. On all power units except that used with the early Model 36 sets, the grid biasing resistance and the plate circuit and filament shunt resistances also are mounted on this panel.

(9) **A line voltage regulating resistance** is used on some of the recent models. This resistance is connected in series with one side of the 110 volt supply line, and it serves to maintain a constant voltage across the primary of the power transformer, automatically compensating for line voltage variations and fluctuations. The resistance of this regulator increases if the line voltage increases above normal, and the resistance decreases if the line voltage goes below normal. This device is mounted on the left-hand side of the power unit container.

SECTION II

PLANNING THE SERVICE DEPARTMENT

1. The Service Room

The first thought of the dealer, once he has been "sold on the idea" of rendering real service, will be a suitable workshop or service room in which to carry on this work, and also the tools and equipment he will require to perform radio service completely and efficiently.

In most cases it will be necessary for the dealer to utilize for his service room whatever location may be available for this purpose under the conditions of his present floor layout, but where there is a choice, or in case of the occupying of new quarters where any desired layout can be planned, it is suggested that the service and parts stock room be arranged adjoining or convenient to the rear of the sales and display room. With this arrangement, customers bringing sets in for service can be referred promptly to the "Service Department," which will avoid unnecessary delay and confliction with the work of the floor salesmen. The dealer's "outside service man" can, of course, enter the shop by the rear entrance.

The service room need not be large, but should be well lighted. If possible to have outside light directly on the service bench or table from one side or the rear, it will enable the service man to work in greater comfort and consequently to produce more efficient results.

2. The Repair Bench

The service bench or "repair table" should be four or five feet long and about twenty inches deep. The height should be about thirty-six inches, so as to permit the repairman to work at it conveniently while standing. The top of the table should be of fairly heavy pine wood, and the legs should be heavy enough to insure the bench being absolutely firm and free from vibration. One or two round-topped stools can be provided for the men when working on jobs requiring some considerable time.

3. Suggestions for Service Equipment

A reasonably complete outfit of meters and tools, which will cover the making of any ordinary tests and repairs, is suggested as an initial equipment for the dealer's service room, and consists of the following:

Voltmeter for testing circuits, 0-50 Volts D. C.
Thermo-galvanometer for "test stand," 0-100 scale.
High resistance triple range voltmeter 0-200 Volts D. C., 1,000 ohms per volt.
D. C. Ammeter, 0-5 Amps. D. C.
A. C. Voltmeter, 0-5 volts.
A. C. line-voltage meter 0-150 volts.
Milliammeter 0-100 M. A.
Tube testing device.
Hydrometer.
Soldering iron and equipment.
Testing prongs with cables (several pair).
Set of small open-end hex. wrenches.
Set of small socket type hex. wrenches.
Assortment of screw drivers, pliers and wire cutters.
Assortment of spring type clips for quick connections.
Assortment of small fuses (1 and 2 Amp. and 100 M. A.).
Pair of special wrenches for removing cone of E speaker (Part No. 9255).
Open end wrench for toggle switch (for 5/8-inch hex. nut).

Note: A magnetized screw driver is of great assistance in removing and inserting screws in places which are ordinarily difficult to get at, and it is suggested the dealer keep one handy. To magnetize a screw driver, simply insert the blade inside a coil about 50 turns of No. 18 or other insulated wire, the terminals of which are connected to a 6 volt battery (see illustration No. 22) and close the circuit for a moment.

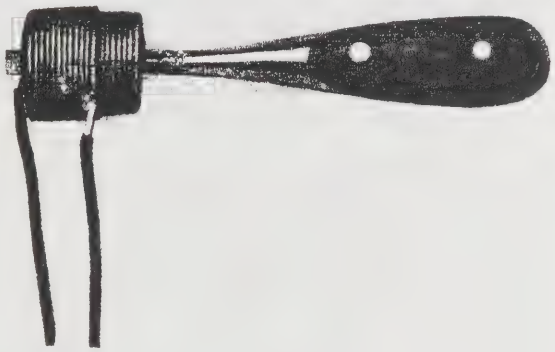


FIG. 22. MAGNETIZING A SCREW DRIVER.

4. Arranging the Equipment

All tools frequently used should be kept in a definite place where they will be accessible without delay. A row of hooks at one end of the work table or on the wall handy can be recommended for this.

It is suggested that the testing meters listed in paragraph 3, with the exception of the galvanometer, low range ammeter and A. C. line voltage meter, be mounted in a row on a wooden or bakelite panel extended up vertically from the rear of top of test table.

Two flexible leads should be attached to the terminals of each meter, these leads being of sufficient length to reach practically to either end of the test table and fitted with testing prongs at the lower terminals. A small single-throw knife switch, mounted just below the meter, had best be inserted in series with one lead from each meter, and a 45 volt dry B battery should be included in series with the 0-50 D. C. voltmeter for continuity tests of circuits. The switches should be left open when the meters are not in use.

The other three meters are used in connection with the "Test-Stand" and their use will be described later on.

. Locating Repair Parts Stock and Repair Material

The best method of arranging the stock of repair arts is to keep them in rows of small wooden bins or glass jars on sets of shelves on the wall. Each bin or r should be carefully labeled with the part number id name.

It will also be advisable to have an additional set of elves for complete sets and speakers—for example a elf for jobs "to be repaired," one for sets "ready for livery," and one for sets "awaiting instructions" from e owner or waiting for parts which have been ordered.

Equipment for the Outside Service Man

The amount and type of equipment provided for the aler's "outside service man" will depend on the total vestment being made in service equipment, and the ility of the outside man in using meters, etc., to locate d perhaps repair minor troubles in the customer's me.

As a rule it is preferable to make only the external ts in the customer's home, and if trouble is found to within the set or speaker they can be loaded into service truck and brought to the shop. This avoids bad psychological effect of making an actual set pair in the presence of the owner.

There are several complete set testing outfits on the rket made by reliable companies such as Jewell, eston, etc., ranging in price from $50.00 to $200.00 more (retail price). These include all necessary tmeters, ammeters, tube testers and, in some cases, oscillator for making reception available when there no broadcasting.

If the dealer does not feel able to invest in one of se outfits, the following set of articles is suggested. ditions can be made as found advisable:

Soldering iron.
Screw drivers, several sizes.
Wrenches, hex., several sizes.
Combination pliers and wire cutters.
Hydrometer.
Voltmeter (preferably high resistance type).
Tubes—One or two of each type.
Headphones or speaker.

The above equipment will provide for checking all eries, tubes and the speaker, as well as the output age of a B Power Unit. Any troubles outside the can thereby be immediately detected and if the diffi- y is traced down to the set it can be disconnected brought to the service shop for the usual routine uit and voltage tests, and necessary repairs.

Keeping Records on Service

This feature is one which the dealer cannot afford to ect if a smooth-running Service Department is to be ntained, and if the avoidance of misunderstandings the customer and unnecessary correspondence with distributor is desired.

Pads of printed forms, serially numbered and with sufficient copies for office records and the customer, should be used for handling repair jobs, and the date on which a set is brought in for repair, date repair is made, and also delivery date with customer's signature obtained, should be carefully entered. The serial and model numbers of the set must always be noted in order to avoid question as to whether the repair is a warranty job.

If a repair "invoice" is made out separately, the number of the repair tag and all other data should be placed on the invoice.

All expenditures in the line of service should be recorded carefully in a book, so that at the end of the year a comparison can be made between the cost of maintenance of the department and the total income from repair work done. The latter will, of course, be made up of the profit in repair parts and the amount charged out for labor on repair work.

We also recommend the keeping of a careful "inventory" of the stock of repair parts. A "perpetual inventory" is the best if care is taken to keep it up to date. A record card should be maintained for each item kept in stock, and the quantity of this item and date received from the distributor recorded, as well as the date and repair number whenever one is used on a repair job. By going over the stock once a month or so, and checking the inventory, any items on which the stock is getting low can be ordered from the distributor and thus an adequate stock of all parts may be kept on hand at all times.

It is also a good plan to keep a complete "service record" of every new set sold, the date of each service call made being noted, together with the adjustments or repairs required. The service expense (or profit) on each set sold can therefore, be determined at a glance.

Some dealers find it well to establish a form of "service contract" with the customer, whereby free service is provided within a certain period, and a nominal charge made thereafter. A printed form signed by both dealer and customer with a duplicate copy for the customer, is necessary for this purpose. A similar "service contract" plan could be arranged equally well for any customer desiring to obtain service for his set on the contract plan, a slightly different form being required in such cases. Such contracts usually cover a year's time and provide for a limited number of service calls at a certain cost, an extra charge being made for additional calls.

8. Service Personnel—the Psychology of Service

In the selection of a man or men to handle the Service Department of his store, the dealer should consider three main factors:

1—Education and experience.
2—Natural ability on radio repair work.
3—Ability to meet the customer.

It is self-evident that to perform satisfactory work as a radio service man, experience along radio lines and ability along the lines of electrical and mechanical repair

work are essential. The third factor, however, is not usually given due consideration, in fact too often it is sadly overlooked.

The Service Department, rather than being looked upon as a necessary evil (as it was several years ago before the dealer had been educated to its true value), is now considered one of the biggest factors for building good-will and indirectly increasing sales that the dealer can possibly have. But this is not possible unless the service man takes the proper attitude toward the customers and his own work. He should always assume the attitude that "the customer is right." He should listen politely to his story of his trouble and endeavor to assure him cheerfully and convincingly that his difficulty will soon be a thing of the past. Confidence in the product and in his own ability will be a powerful factor in the service man's favor in this connection. He should never argue with a customer and never make promises he cannot fulfill. All appointments made should be kept without fail.

All in all, a proper understanding of the psychology of service on the part of the service man will help to make the Service Department a still greater asset to the eventual success of the radio dealer's business.

FIG. 23. TWO VIEWS OF A WELL-LAID-OUT SERVICE ROOM.

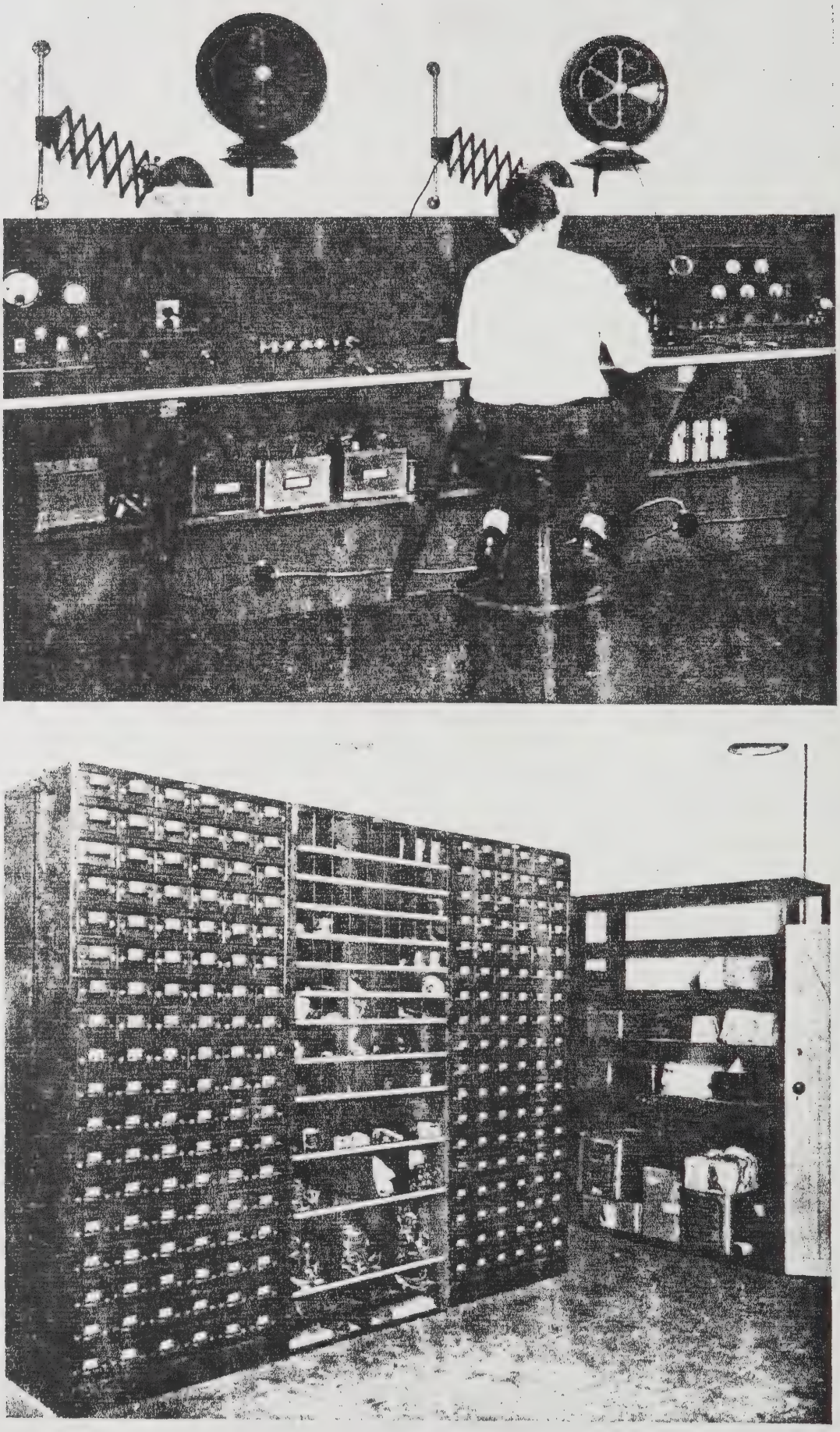


FIG. 24. ANOTHER WELL-ARRANGED SERVICE DEPARTMENT.

SECTION III

USING THE SERVICE EQUIPMENT

1. Continuity Testing with Voltmeter

One of the most important as well as the quickest and simplest methods of locating trouble in a set, is by testing the "continuity" of the various circuits, that is checking to see if the circuit is complete. This is done by means of the low range D. C. voltmeter, the type suggested in our "List of Equipment" being a meter reading from 0-50 volts. This is connected in series with a 45 volt dry B battery, and the terminals of this hook-up are fitted with test prongs which can readily be applied to any two points on a set.

Where the resistance of the circuit being tested is low, the meter should read practically the full voltage of the battery. In testing through the windings of a transformer or resistance unit, however, there will be a corresponding drop in voltage, and when testing across a condenser, which is, of course, an insulator for D. C. (direct current), no reading should be obtained. If the results experienced on a certain test vary from the above general outline, trouble in the circuit or unit being tested is indicated.

A complete set of continuity test charts for the circuits of our sets is contained in Section VI of this Manual.

2. Voltage and Current Tests during Operation

(a) Advantage of Voltage Tests

It is frequently desirable to test the actual voltages being delivered to the various circuits of the set by the power supply, while the set is under actual operating conditions. It is obvious that any factor which would cause the applied voltage to vary much from the correct value required by the tubes and the design of the set, would result in improper functioning and possibly damage to the set or tubes. Consequently, if incorrect voltage supply is suspected as the cause of an ailment it is well to make an immediate check with the proper instruments.

For testing both the A and B voltage of battery type sets, and the B voltage on A. C. sets, a high resistance volt-meter should be used. The best type is one having several ranges such as 0-10, 0-100 and 0-200, any one of which can be used by changing connections on the meter.

(b) Testing Filament Voltage—Battery Type Sets.

The low range 0-10 terminals are used when testing the A voltage delivered to the set, this voltage being obtained by applying test prongs from meter to the

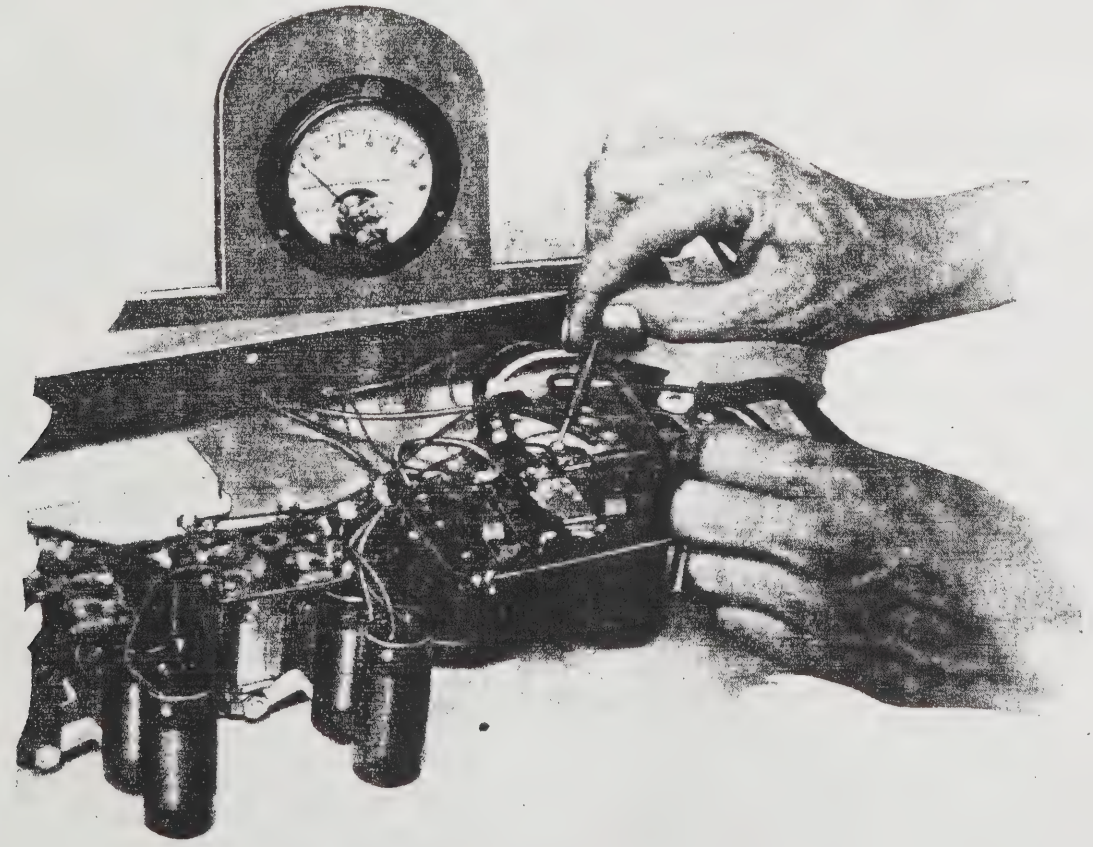


FIG. 25. TESTING CIRCUIT CONTINUITY WITH VOLTMETER.

"minus A" and "plus A" cable terminals of the set—or if the voltage on a particular tube is desired, the test prongs can be applied directly to the socket fingers (+F and —F) of that tube, assuming the set has been removed from the cabinet for testing purposes.

(c) Checking Plate or B Voltage

The high range terminals of the voltmeter are used for measuring the B voltage delivered to the tubes, either at the terminals of the B Power Unit, B batteries (or power unit in the A. C. sets), or across the tube socket plate "P" contact (corresponding to plus B) and the filament cable terminal. For example, to measure the plate or B voltage on the R. F. tubes, the test prongs should be applied to the white and either the red or black cable terminals of set, or for a particular R. F. tube one prong to contact "P" of that tube socket and the other to either one of the filament contacts of the same tube.

The intermediate range terminals on the meter can be used for measuring such voltages as the detector B voltage or the C voltage on a 171 type power tube.

(d) Filament Voltage—A. C. Sets

For testing the "A" or filament voltage on the tubes in A. C. sets, the low range A. C. voltmeter is used. It should be noted that the detector, amplifier, and power tubes in these sets receive different A voltages respectively. Each voltage is tested by applying the test prongs from this voltmeter to the proper corresponding pair of filament circuit terminals on the power unit (where connection is made from set to power unit), or at the tube socket contacts if the reading for a certain tube is desired. Individual voltage readings on each 226 tube can be taken without removing set from cabinet by inserting test prongs in eyelets at edge of socket, located over filament contact springs.

A complete voltage table for all sets will be found at the end of Section VI.

(e) "C" or Bias Voltage—A. C. Sets

This can be easily checked with the high resistance D. C. voltmeter, using the medium range scale for the last audio tube, and the low range for the first audio tube. Insert testing prongs into eyelets of tube socket corresponding to the grid and filament contact fingers.

(f) Milliammeter—Checking Plate Current

This instrument is chiefly used to check the amount of plate current being drawn by a tube or group of tubes in order to determine if it is normal. For example, an excessive plate current consumption by the R. F. tubes may indicate a leaky R. F. by-pass condenser, while an abnormal plate current being drawn by a power tube may indicate incorrect "C" or bias voltage. (It is assumed, of course, that the tubes themselves have been checked.)

To use this meter, place the test prongs from it in series with the particular plate circuit to be tested. The easiest way to do this is to disconnect the cable wire supplying that circuit at its lower terminal (at the source of power) then connect one meter test terminal to the end of cable thus released and the other to the post from which it was removed. Where there are several tubes in parallel on the same plate voltage supply, a test of the plate circuit on one of them will require opening the plate circuit of that tube near the plate contact of socket and applying the testing terminals to the ends of the circuit thus opened.

(g) Testing Grid Leaks

The best way of testing a grid leak is by means of a special and rather expensive device known as a "megger." As it would hardly be economical for the dealer to purchase one of these, we suggest the following test. Connect the set up for receiving, tune in a loud broadcasting signal and place the hands on first and last R. F. transformers. This should stop the reception almost entirely. Upon removing hands from the transformers, the signal should return instantly. If it hesitates for just a second or more, this is an indication of a poor grid leak, and a replacement should accordingly be made.

3. Testing Repaired Sets—Output Measurement

The simplest method of testing a set which has been repaired is, of course, to try it out on broadcast reception, judging the volume by ear. This method, however, is not very accurate, and as broadcasting is not always available and it is usually desirable to test reception on several wave lengths, an outfit consisting of a device capable of producing a signal on any of several definite wave lengths, and a "galvanometer test stand" for comparative measurement of volume of reception, is recommended. As a matter of fact such an outfit is now standard equipment in practically every modern radio service shop.

(a) Signal-Producing Apparatus

There are several forms of set-up which can be used for producing a steady signal in a radio receiver for testing purposes, and it is not our policy to recommend any particular type here.

The best plan for the dealer who desires to purchase or build one of these outfits is to communicate with his territorial distributor, whose service men have been fully instructed by our factory field service men along these lines.

In the event that there is any difficulty in handling the matter in this way, the dealer is at liberty to purchase or build a standard outfit for the purpose as described and advertised in various radio magazines, and set it up himself in accordance with the instructions furnished.

For convenience in describing the use of the test stand in the following paragraphs, the signal-producing apparatus will be referred to as the "transmitter," however, it is understood that the signal produced is of sufficient strength for set testing only.

(b) The "Galvanometer Test Stand"

This apparatus is essentially a contrivance for measuring the volume with which the signal from the transmitter is obtained on a receiving set, thereby indicating the sensitivity and condition of the set. The chief element in this outfit is a thermo-coupled galvanometer, to which the set to be tested is connected through an additional (third) stage of audio amplification followed

by a special "step-down" transformer, the secondary terminals of the latter being connected to the galvanometer. It should be clearly understood that the reading obtained on the galvanometer when a set is tested is of value only as a comparative reading—that is when compared with a standard set with a predetermined standard value.

The photograph below shows a form of test stand used in our factory service department. A "standard" receiving set is permanently connected to this stand,

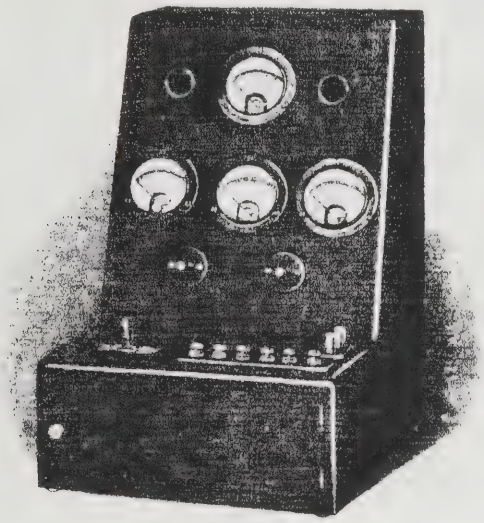


Fig. 26. Test Stand.

thereby permitting the comparative output of any set of the same type to be readily checked. A standard anti-capacity switch is used to connect the galvanometer outfit to either the standard or test receiver, as shown on the schematic wiring diagram of the complete test stand which appears on the next page. This diagram shows two permanent sets of connecting posts, one for a standard set and one for the "test" set, of the battery type, with the necessary supply cable leading to the power supply source; and also a "triple tap" receptacle permitting two sets to be connected to the 110 volt A. C. line when an A. C. set is to be compared with a standard.

When changing from a battery type standard set to an A. C. standard (or vice versa), it is only necessary to transfer the output leads from the speaker posts of one standard to the other and the antenna wire of the transmitter, from the antenna post of one standard to the other. A D. P. D. T. and an S. P. D. T. knife switch can be installed to accomplish these changes quickly.

(c) Procedure for Testing Sets

A suitable transmitter and the test stand described above comprise a complete outfit for testing the performance of any set in a very short space of time.

In order to facilitate the testing of any type of set a "standard" should be maintained for each type—either an actual standard set, selected as having the average output of several sets of its type known to be in good condition, or simply a standard value of output can be set as an arbitrary requirement. In describing the testing of a set below, it will be assumed that an actual standard set has been selected and is properly connected to the test stand.

To test a set, place it on the test bench convenient to the test stand, connect cable wires to proper binding posts on stand (if an A. C. set, simply plug in the "triple tap"), and antenna post to switch carrying antenna lead wire from transmitter. Turn on transmitter and adjust tuning control on same to a low wave length adjustment. Throw switch on test stand and antenna switch over to the standard set and "tune in" the signal on this set so that maximum reading is obtained on the galvanometer. Adjust tuning control of transmitter so that the signal comes in at 20 on the dial of the standard, then adjust position of antenna wire from transmitter till reading on test stand galvanometer is around 60, with volume control of set full on.

Now throw toggle switch and antenna switch over to the set being tested. If this is a battery set, the next procedure is to insert the tubes one at a time, noting by the filament ammeter "A" whether the proper current (¼ amp. each) is being drawn by the tubes. If the set being tested is an A. C. type, the tubes should all be inserted before the A. C. power plug is pushed into the receptacle. Turn dial of set being tested to approximately 20, the volume control being turned full on. The maximum galvanometer reading obtained around this point will give the comparative output of the test set with the standard.

Next set the transmitter tuning control so that a medium wave length signal is sent out and repeat the above procedure, adjusting so that a maximum reading is obtained around 50 on the dial of the standard set. Then compare the output of the two sets on this wave length.

Repeat same again with transmitter adjusted to a high wave and secure comparative readings at 80 on the dial of each set.

By comparing the volume of output of a set with a standard on three wave lengths by the above method, a very accurate idea of the performance of the set is obtained, since any defect in the set, such as an open circuit, or incorrect adjustment of the condensers, will readily be indicated by an abnormally low volume reading on the galvanometer. A reading of 20% or so below standard is, however, allowable.

(d) Special Notes

1—Tubes used in the standard sets should be very carefully selected with the aid of the dealer's tube-testing equipment.

2—It will be noted that the ammeter listed in the "Suggestions for Service Equipment" (Section II, paragraph 3) is employed in the test stand, in addition to the galvanometer. Several small fuses and switches, the purpose of which is self-evident, are also employed in the test stand circuit. The voltmeter for checking A. C. line voltage is connected across the A. C. line through the "triple tap," the connection between the first and second taps being broken and a single throw knife switch inserted between them.

3—Note that a pair of headphones or a loudspeaker unit is inserted in series with the plate circuit of either set, for checking the volume and quality of the signal from the signal-producing apparatus.

4—If desired, switches can be installed to arrange for a test on outside broadcasting as well as on the test transmitter, thereby giving a still more complete test.

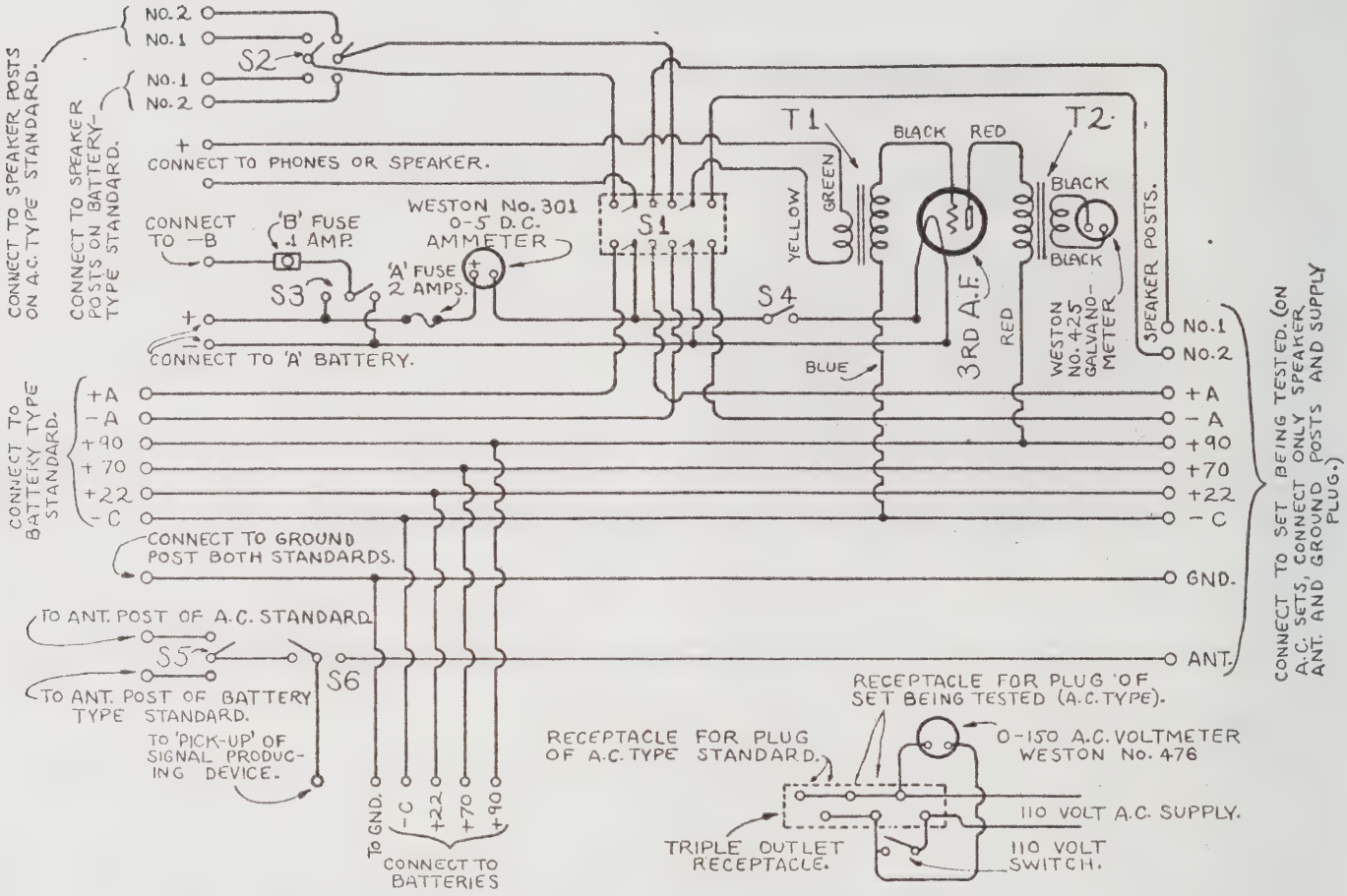


FIG. 27. WIRING DIAGRAM OF TEST STAND FOR A.C. AND BATTERY-TYPE RECEIVERS.

S1=Federal No. 1424 toggle switch (four pole, double throw) to switch phones and input of 3rd A.F. amplifier from standard to set being tested, and to change "A" battery from standard to set being tested (with battery-type sets).

S2=Double pole, double throw switch to change phones and input of 3rd A.F. amplifier from A.C. standard to battery-type standard.

S3=Single pole, double throw switch to change —B from +A to —A.

S4=Toggle switch to turn filament of 3rd A.F. amplifier "on" or "off."

S5=Single pole, double throw switch to change "pick-up" from A.C. type standard to battery-type standard. S5 and S2 may be combined to form a triple pole, double throw switch.

S6=Single pole, double throw switch to change "pick-up" from standard to set being tested.

T1=Atwater Kent No. 7660 audio frequency transformer.

T2=Atwater Kent special step-down audio frequency transformer.

NOTE.—The battery type standard may be a later-type Model 35 (with 17 plate variable condensers). The A.C.-type standard may be a Model 38 or 44.

NOTE.—Connect +C to —A.

SECTION IV

TROUBLES DUE TO EQUIPMENT, LOCATION AND INSTALLATION

1. Troubles Usually Not In Receiver

The first thought of the radio user, if his reception should deviate from its normal satisfactory functioning, is that the cause of the trouble is in his receiver.

The service man, however, will find in the majority of cases that something other than the set itself will be causing the trouble—either a defective tube, broken aerial or ground connection, battery trouble or some similar cause. Perhaps the customer himself is at fault, in not understanding the set, or he may be expecting the impossible. Perhaps the dealer who made the sale recklessly "oversold" the customer with unlimited promises of distant reception.

2. Method of Procedure In Locating Trouble

The accessories and installation should therefore be carefully checked first, and the general character of the location noted with a view to determining what sort of reception should be expected.

The method of procedure in locating the cause of a particular trouble will, of course, depend on the nature of the complaint. The dealer with even a moderate amount of experience in radio will instinctively know the step-by-step procedure in getting at the bottom of each type of complaint. In Section VIII will be found a "Chart of Troubles and Probable Causes" which will be of aid in doubtful cases, and below we are listing briefly the most frequent possible causes of trouble other than in the receiving set itself.

3. Classification of Troubles Due to Accessories

(a) Location

The conditions immediately surrounding the home in which a radio is installed will have a great influence on the success obtained in reception, particularly of distant stations.

In the immediate vicinity of numerous steel buildings, other aerials, powerful local broadcasting stations, etc., maximum results cannot be expected, although sometimes surprisingly good reception is experienced under adverse conditions. The ideal location for clearness and distance is in the open country on high ground, with as few surrounding objects, electric wires, etc., as possible, in the immediate neighborhood, although remarkable results are frequently obtained in locations which would ordinarily appear somewhat unfavorable.

In many cases, it is rather difficult to explain these facts to the radio owner, who does not understand why his set, in a downtown apartment house, will not bring in the distant stations as clearly as his cousin's set of exactly the same type located in the suburbs or the country. If, however, he can be induced to take his set to his cousin's home and connect it up there, his doubts will soon disappear, and he will be surprised at the performance of his set under the vastly improved local conditions.

(b) Aerial

May be (a) grounded, (b) touching foreign objects, (c) connections corroded; (d) lead-in may be broken inside insulation.

(c) Lightning Arrester

May be (a) leaky, or (b) short circuited.

(d) Ground Connection

May be (a) corroded where connected to pipe or other source of ground (b) ground lead may be broken inside insulation; (c) source of ground may be inefficient (dry earth, etc.).

(e) Batteries and Battery Eliminators

"A" or storage battery may be (a) discharged or run down—indicated by weak signals and necessity for advancing rheostats of set full on—temporarily relieved by turning off set for a short time if battery is not completely discharged. (b) Corroded connections at "A" battery terminals cause noisy and intermittent reception. Posts should be scraped clean and coated with vaseline to prevent further corrosion. (c) Reversed connections to the "A" battery will cause the set to be extremely weak. This simple trouble is found more frequently than might be thought possible, especially in cases where the battery is sent out to be recharged and is reconnected by the customer.

"A" battery eliminators. These are of various design and construction, and unless the dealer himself is handling them and has instructions for repair, it is better to refer the complaint to the seller or manufacturer of the device.

"B" batteries and "B" eliminators, particularly if of the liquid types, are often found to be the cause of a set becoming inoperative. Run down "B" batteries cause weak, noisy reception. A 45 volt dry "B" unit should be replaced when its voltage has dropped to 34 volts. This voltage should be measured with the set turned on.

Occasionally incorrect cable connections to the "B" battery will be found. All connections should be carefully checked by the service man, following the wiring diagram in the instruction book supplied with the particular set being tested.

One of the first steps the service man will make in testing for trouble, therefore, will be to test the voltage of the "B" batteries (dry or storage) with a voltmeter, and check the connections to them from the set.

"B" eliminators or power units are of many different types, the two main varieties being the tube rectifier type (such as our Model R) and the Electrolytic or liquid type. The voltage delivered by the unit should be checked with a high resistance voltmeter while the set is turned on, and if it is seriously incorrect, reference should be made to the service literature covering the particular make of unit, or the unit should be sent to the local representative for inspection.

(f) Tubes (D. C. and A. C.)

Defective tubes, both in A. C. and D. C. or battery type sets, are one of the most common causes of trouble in reception. A tube may light perfectly and yet be "dead" so far as reception is concerned, due to a loss of electronic filament emission.

In general, all tubes become weak or lose their sensitivity after a period of use, and the useful life of a radio tube generally ceases long before the filament actually burns out. Weak tubes can sometimes be brought back to normal functioning, at least temporarily, by the so-called "rejuvenators."

Occasionally, due to faulty interior construction, the internal elements of a tube will touch one another, causing a short circuit. If the grid and plate of a tube come in contact, due to their supports not being rigid or possibly to a slight jar to the set, while the set is connected up (but not necessarily turned on, if a battery set), the plate current will pass through the grid circuit, usually wholly or partly burning out the "grid resistance unit" and sometimes also the primary of the R. F. transformer. Unfortunately, when this occurs the filament of the tube is usually involved, resulting in its burning out, and rendering the tube unfit for further use. If the defective tube is in the first R. F. socket, the choke coil or coupling transformer will be the element of the set through which the plate current passes, consequently it will burn out.

There are also cases where this short circuit of the internal elements is only momentary, due to a slight shock or jar to the tube, unnoticed at the time by the set owner. In this case the damage may be only the partial or complete burning out of the grid resistance or choke coil, without damage to the tube itself. The latter will then function properly, but may again cause similar trouble at any time without warning. It is therefore very important that any tube which is suspected of having this defect, be located and replaced before further damage is done.

A. C. tubes, during the first few months after they appeared on the market, were subject to some rather peculiar troubles. The detector tube occasionally showed a tendency to develop trouble after a short period of use, under a line voltage only slightly in excess of normal. This has been attributed to the heavy current surge through the filament the instant the set was turned on. This condition has recently been almost entirely overcome by changes in the internal design of the tube. A defective A. C. amplifier tube of the "226" type may cause a hum in reception.

For best results it is advisable to use standard tubes of established national reputation. Information relative to the use of "power tubes" in our various battery type sets is contained in Section XI.

(g) Speaker

In a small percentage of cases of trouble in reception, the speaker will be found at fault. An open circuit in the magnet coil winding will make reception practically impossible, while incorrect adjustment or other abnormal conditions may cause distortion or lack of volume.

For this reason it is always advisable for the outside service man to have a speaker or reproducing unit of some sort in his service kit, for comparison purposes.

Where an inferior brand of speaker has been sold with an Atwater Kent receiver, as is sometimes done in order to make possible a lower or "bargain" price on the complete outfit, the performance of the set will naturally suffer to some extent, and the service man should in all such cases suggest replacing the present speaker with an Atwater Kent cone type, demonstrating one on the spot if available.

(h) House Current Supply (A. C. Sets)

Successful performance of an A. C. set will not be possible under conditions of line voltage other than those for which the set was designed. It need hardly be mentioned that attempting to use our standard 110 volt, 60 cycle sets on 110 volts D. C., 220 volts A. C., 32 volt farm lighting systems or 25 cycle, 110 volt A. C. lines will have disastrous results.

An allowable limit of ten volts either way, is permissible on the A. C. sets. Voltages below 100 will not permit maximum volume, while voltages above 120-125 would have a tendency to shorten the life of the tubes, except in the case of certain models, which are equipped with an automatic voltage regulator in the A. C. line, permitting line voltage variations up to 130 volts to be satisfactorily handled.

In localities where the A. C. line voltage runs from 10 to 20 volts or more above the standard value, at suitable resistance unit or voltage regulator may be used to bring the voltage to normal value. There are several such devices now being made by reputable concerns, and will be found advertised in current radio magazines. These devices are, of course, unnecessary with the sets having the automatic voltage regulator, unless the line voltage is excessively high (above 130 volts).

SECTION V

OUTSIDE INTERFERENCES—CAUSES AND REMEDIES

In addition to the cases in which unsatisfactory radio reception is due to faulty equipment or installation, there is also a considerable percentage of instances where disturbances due to external causes are responsible for the failure of a set to deliver satisfactory performance. In other words, a radio set will respond to other electrical radiations besides those of the broadcast stations, and in some cases these other radiations are of such intensity as to "drown out" distant, or in some cases, even local reception.

1. Determining if the Cause is External or Internal

The simple expedient of disconnecting the antenna and ground lead-in wires from the set, while it is in operation and the disturbance is being heard, will readily determine whether or not the noise is due to an external radiation or to some abnormal condition within the radio installation itself. If the noise disappears with the removal of the lead-in wires, it is undoubtedly due to external causes. The simplicity of this test will usually convince the most ignorant or skeptical radio owner.

2. Classification of External Causes

(a) Static

"Static" is a rather broad word used to cover the noises in reception caused by electrical discharges in the atmosphere due to natural causes. There is always a certain amount of this present, and the more sensitive the receiver is, the more readily it will be detected. A seven-tube tuned R. F. set will bring in static which might not be noticeable in a three-tube set, but, of course, the response to distant broadcast signals will be greater in the same proportion.

Static may be recognized as a crackling, crashing and rumbling sort of sound, usually intermittent and irregular in intensity. It is worse at night than during the day and worse in summer than through the winter. In the tropical localities it is present throughout a greater portion of the year.

The use of a long, low aerial, or even an "underground" aerial, one of the patent shielded types; or the disconnecting of the ground lead from the set, will frequently reduce the amount of static received, at some sacrifice in volume of the broadcast reception. It will be found best when listening under bad static conditions, to tune the desired station to maximum with the "station dial" and then turn down the volume control till a very moderate volume is obtained.

(b) Code Signals.

This noise is in the form of an intermittent buzzing or "peeping," resembling telegraphic code (dots and dashes), and is due to the operation of a powerful wireless telegraph transmitter, either commercial or amateur, in the immediate vicinity. Even if this transmitter is sharply tuned, if it is sufficiently close and powerful it may cause interference through "forced oscillations," which cannot very well be prevented. If it is a case of an improperly tuned transmitter, this can be reported to the Federal Radio Commission.

(c) Radiating Receivers

The familiar squeal or "cat-call," varying in intensity and volume, which is sent out or broadcast, when a regenerative or other oscillating receiver is "tuned in," is gradually disappearing from among the annoyances to which the broadcast listener is subject, as this class of set is steadily becoming obsolete and being replaced by the "stabilized" types. Interference of this kind can only be eliminated at its source, by proper operation of the offending receiver. Such cases can best be handled personally, by using diplomacy and tact with the owner of the trouble-causing set.

(d) Electrical Apparatus and Wiring.

Electrical machinery in operation and defective electric wiring is probably responsible for more "background noise" in radio reception than any other cause, particularly in a city or town where there are always many electrical devices, appliances and machinery in more or less continuous operation.

The nature of the noise in each case will depend upon the type of machinery causing it and the nature of the defect or electrical discharge responsible for the radiation of the disturbance. Among the more common sources of trouble of this nature may be mentioned:

Electric motors or generators,
Arc lights,
Household electric appliances,
Flashing signs,
X-ray or violet-ray machines,
Battery chargers (vibrating type),
Leaky electric power wiring,
Farm lighting systems,
Telephone bell-ringers,
and numerous other forms of electric apparatus, in fact any device which produces a spark while in operation.

The source of the noise can sometimes be found by careful investigation of the presence of electrical appliances, defective wiring, loose fuses or lamps, etc., in the building or the immediate neighborhood. For the tracing of larger and more obscure sources, however, the use of a small portable receiving set, operating from a loop antenna, can be resorted to. Tests made with such an outfit, located at various points in the neighborhood of the disturbance, noting the intensity of disturbance and direction the loop points, will often enable the origin of the interference to be located.

3. Remedies

It would not be possible here to attempt to suggest remedies for the various noises caused by different forms of electrical apparatus, however, we may say that generally speaking, the only satisfactory remedy in most cases consists of some sort of filter applied to the source of the disturbance, that is the sparking contacts from which the interfering radio frequency currents are radiated. This filter will consist of either a simple condenser, two condensers in series with a ground lead from the point of their connection, or two condensers so connected, in conjunction with R. F. chokes.

In a few cases some improvement in reception is had by changing the position of the receiving aerial, but the most practical procedure is to locate the source and apply one of the forms of filter suggested.

For a detailed treatise on this subject the dealer is referred to the "Manual on Interference" published by the Radio Manufacturers' Association.

SECTION V-a
DESCRIPTIVE LIST OF ATWATER KENT RECEIVERS

Part No.	Model No.	Tubes	
			"Open" or Board Type Battery Sets
4052	..	4	Type "11" tuner, 1 stage fixed R.F., det. and 2 stage amp. unit, potentiometer control.
4066	..	5	Type "11" tuner, 2 stages fixed R.F., det. and 2 stage amp. unit, potentiometer control.
4340	10	5	Two stages tuned R.F., 3 variable condensers, 3 R.F. transformers, detector, 2 stage unit and potentiometer. Gray-green condensers.
4445	9	4	One stage tuned R.F. amp., 2 tuners and det. 2 stage unit, potentiometer control.
4333	5	5	Type "11" tuner, 2 stages fixed R.F., det. and 2 audio—all tubes in one metal container.
4600	10	5	Two stages tuned R.F.—3 var. condensers, etc., same as No. 4340, but different wiring.
4550	10A & 10B	5	(10B has 3 tap ant. switch.) Similar to 4340. Brown conds., with battery cable attached.
4560	10A & 10B	5	(10B has 3 tap ant. switch.) Same as 4550, but black variable condensers.
4620	12	6	Two stages R.F., det. and 3 stages audio—3 variable condensers, cable attached.
4700	10	5	Similar to 4340 & 10B 4550-4560. No pot. One R.F. rheostat only for both R.F. tubes.
4910	12	6	Similar to 4620, but with switch to control last audio stage, and no potentiometer.
			Cabinet Type Battery Sets
4640	20	5	Two stages tuned R.F., large cabinet, 3 dials, 3 pt. ant. tap switch, 2 rheostats.
4880	19	4	One stage tuned R.F., large cabinet, 2 dials, 3 pt. ant. tap switch, 2 rheostats.
4920	24	5	Same as 4640, but in "deluxe" cabinet, with feet.
7570	20 Compact	5	Small mahogany cabinet, 3 dials, tap switch, battery cable attached.
7780	21	5	Same as No. 7570, but with sockets and rheostats for 3-volt dry cell tubes.
7960	20 Compact	5	Same as No. 7570, but with "UX" type sockets and other refinements.
8000	30	6	One tuning dial, small mahogany cabinet, two rheostats, 3 stages R.F.
8100	35	6	Metal cabinet, tubes inserted from bottom—one dial, one rheostat, ship-type name-plate.
8270	32	7	Long cabinet, one dial, two rheostats—4 stages R.F. double R.F. transformers.
8930	33	6	Small mahogany cabinet, one dial, ant. adj. knob, two rheostats, double R.F. transformers.
8500	50	7	Large deep mahogany cabinet, several metal shielded compartments inside, one dial, antenna adjusting knob, 2 rheostats.
9840	48	6	Similar to Model 30, but gold panel.
9860	49	6	Similar to Model 33, but gold panel.
			A.C. Sets—Using "A.C. Tubes"
9390	36	6 and rect.	Small mahogany cabinet, same as Model 33; Type Y (metal), A.C. power unit goes with Model 36 set.
9500	37	" " "	Metal cabinet contains set and power unit, 3 stages R.F., 1 dial, 1 volume control knob, ship-type nameplate.
9400	38	7 " "	Same as Model 37, but double R.F. transformers and 4 stages R.F. amp., 1 dial.
9800	40	6 " "	Same as Model 37, metal cabinet, but black dial and volume knob and other minor differences; modernistic nameplate.
9850	42	" " "	Same as Model 40, but with automatic voltage reg., ball feet, dial in 5 divisions.
9900	44	7 " "	Same as Model 42, but with double R.F. transformers, 4 stages R.F. amp.
9930	52	6 " "	Console type—metal stand, speaker in base, antenna and ground leads supplied; set chassis same as Model 42.
			Direct Current (110-Volt) Sets
9910	41	7	Metal cabinet contains set and power unit, 3 stages R.F., detector, 2 stages A.F. (last stage "push-pull" type, 2 tubes, one mounted on right-hand side of power unit). Filaments in series. Chassis similar in appearance to Models 37, 40, 42 and 52.

SECTION VI

SERVICING RECEIVERS AND A. C. POWER UNITS

When a thorough inspection of the customer's installation, etc., shows conclusively that the cause of the trouble lies within the set itself, the best plan is for the service man to disconnect the set and take it to his shop for test and repairs.

In a few cases, where the trouble is a very minor one, it would perhaps be permissible for the service man, if experienced and capable, to make repairs in the set owner's home, but with the full shop equipment and absence of a critical audience, a more satisfactory and permanent job can almost always be done.

Moreover, it is always well to apply a complete voltmeter test to a set which has given trouble, as well as to check the alignment of the condensers and thoroughly inspect the wiring with a view to eliminating the possibility of any future trouble developing.

The main tests to be applied to a set which comes in for repair, may be classified as follows, applied in order named:

(1) Visual inspection.
(2) Continuity tests, with volt-meter.
(3) Voltage tests (A. C. sets only).

The conducting of these tests will now be outlined.

1. Visual Inspection

In order to make a satisfactory visual inspection of the wiring and condition of the parts in a receiver, it is necessary to remove the set from the cabinet. This presents no particular difficulties, and by following instructions given in connection with service data on individual sets, the procedure can be accomplished in a minimum of time.

Points for Inspection

The following features should be given special attention in making the general visual inspection:

1—SOLDERED JOINTS—examine for firmness. A poor physical joint means a poor electrical connection. **Note especially ground lug connections.**

2—SCREWS, BOLTS AND NUTS—must be all tight.

3—INSULATION ON WIRING—must be perfect and not cut or frayed through where it passes metal edges of tube contacts, etc.

4—TUBE SOCKET FINGERS—should be clean and tight.

5—SWITCHES—switch blades should be clean and make good contact.

6—DIALS—should not scrape on panel.

7—GRID RESISTANCES—note if intact and tightly riveted on.

8—R. F. TRANSFORMERS—examine for loose or damaged coils, or bad connections at terminals.

9—VARIABLE CONDENSERS—check for foreign particles between plates and note spacing between rotary and stationary plates.

10—RHEOSTATS or VOLUME CONTROL—must operate smoothly.

11—POWER SUPPLY CABLE—note condition of insulation on leads and condition of terminals at power end.

12—POWER UNIT (A. C. SETS)—cable connection panel must be bolted down tightly.

13—SUPPLY CABLES (A. C. SETS)—note if cut by power unit lid.

2. Continuity and Voltage Tests

After set has been thoroughly checked by visual inspection in accordance with paragraph 1, the next step toward locating possible defects will be to apply the series of circuit continuity tests. These tests should be made even though the condition which apparently caused the complaint has been located through the visual inspection.

In case of the A. C. sets, it will be necessary also to check the voltages supplied to the various circuits by the power unit. Voltage tests are unnecessary in the case of the battery type sets, since the batteries or other sources of voltage are usually checked individually before attempting to apply any tests to the set chassis.

The following pages contain complete sets of continuity tests for all A. K. receiving sets manufactured since 1924, and also for the power units used in the A. C. type receivers. A complete voltage table covering all A. C. sets will be found at the end of this section.

The following abbreviations are used in the continuity test charts:

Abbreviation	Meaning
1 R	1st radio frequency socket
2 R	2nd " " "
3 R	3rd " " "
4 R	4th " " "
D	Detector socket
1 A	1st audio frequency socket
2 A	2nd " " "
3 A	3rd " " "
+ F	Positive filament contact
— F	Negative " "
G	Grid contact
P	Plate "
C (in A. C. sets)	Cathode "
R. F. T.	Radio frequency transformer
A. F. T.	Audio " "

In the tables, to identify a certain contact of a certain socket, the abbreviation of the contact is combined with the abbreviation of the socket.

Thus the grid (G) contact of the third R. F. socket is referred to as G3R. The negative filament contact of the second A. F. socket is referred to as —F2A, the cathode of the detector socket (in A. C. sets) would be CD, P2A would mean the plate contact of the second audio frequency socket, and so on.

The use of these symbols will enable the service man quickly to recognize the corresponding socket on the set without having to refer to the chart or wiring diagram.

Model 10B Receiver—Test Chart, Continuity Table and Diagram

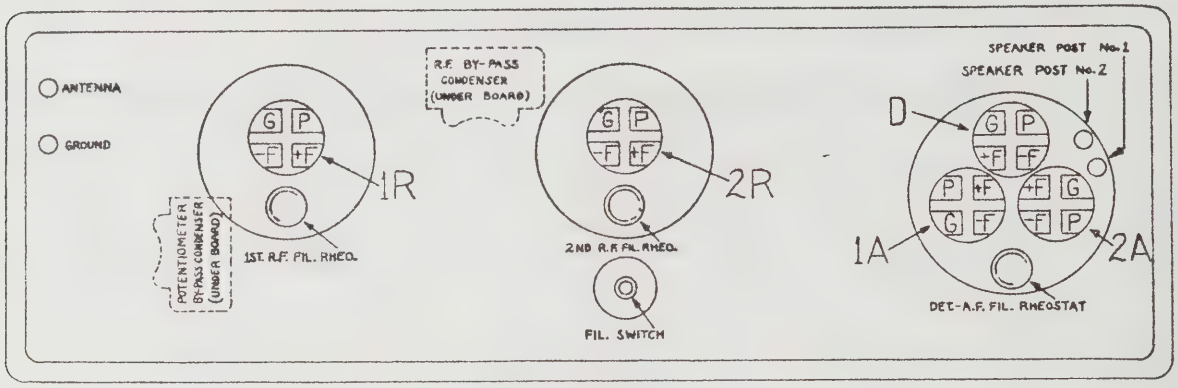


FIG. 28.

(For Following Tests, Place Filament Switch "On," Rheostats Barely "On" and Potentiometer Pointer to Left)
NOTE: Unsolder +F Lead to Potentiometer, and One Lead to Potentiometer By-Pass Condenser.

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
Each cable lead end to corresponding soldered cable connection under board.	*Full*	Open in cable.	**Examine cable for broken leads and short circuits. Repair or replace cable if necessary.**
BLACK to			
—F1R	*Full*	Open 1st R.F. fil. rheostat or connection.	Examine joints under board.
—F2R	*Full*	Open 2nd R.F. fil. rheostat or connection.	Examine joints under board.
—FD, —F1A, —F2A	*Full*	Open Det.-A.F. fil. rheostat or connection.	Examine joints under board.
Ground Post.	*Full*	Open ground connection.	
Antenna Post.	*Full*	Open antenna coil or connection.	Test with ant. switch on each tap.
G1R	*Full*	Open antenna coil or connection.	
P1R, P2R	*None*	No. 1, 2 R.F.T. primary circuit grounded.	Check transformer connections.
PD, P1A	*None*	No. 1, 2 A.F.T. primary circuit grounded.	Examine connections.
G2R	*Full*	Open secondary No. 1 R.F.T.	
G1A, G2A	*Partial*	None—Open secondary No. 1, 2 A.F.T.	Full—Shorted secondary.
RED to			
+F of Each Socket.	*Full*	Open positive filament wire or connection.	Examine joints under board.
PD	*None*	Shorted phone condenser.	Located inside 3-tube container.
GD	*None*	Shorted grid condenser.	Located inside 3-tube container.
P1R	*None*	Shorted R.F. plate circuit by-pass condenser.	Install new type by-pass cond.
WHITE to P1R	*Full*	Open primary No. 1 R.F.T.	
WHITE to P2R	*Full*	Open primary No. 2 R.F.T.	
YELLOW to PD	*Partial*	None—Open primary No. 1 A.F.T.	Full—Shorted primary.
BROWN to			
P1A	*Partial*	None—Open primary No. 2 A.F.T.	Full—Shorted primary.
Speaker Post No. 2.	*Full*	Open connection.	
OTHER TESTS			
Across End Terminals of Potentiometer.	*Nearly Full*	None—Open potentiometer.	Full—Shorted potentiometer.
Across Terminals of Potentiometer Cond.	*None*	Shorted potentiometer by-pass condenser.	Located under board, left-front. Install new type by-pass cond.
BLACK to			
Center Contact of Potentiometer (turn knob.)	*Nearly Full*	Open connection to slider.	

Resolder Connections to Potentiometer and By-Pass Condenser.

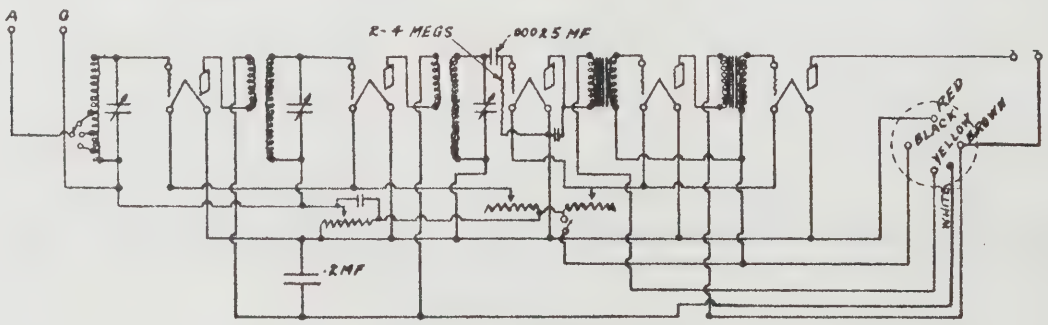


FIG. 29.

NOTE.—This set has two R.F. rheostats (one for each R.F. tube). —F1R connects to the slider lead of the 1st R.F. rheostat instead of to —F2R.

Model 10 Receiver—Test Chart, Continuity Table and Diagram

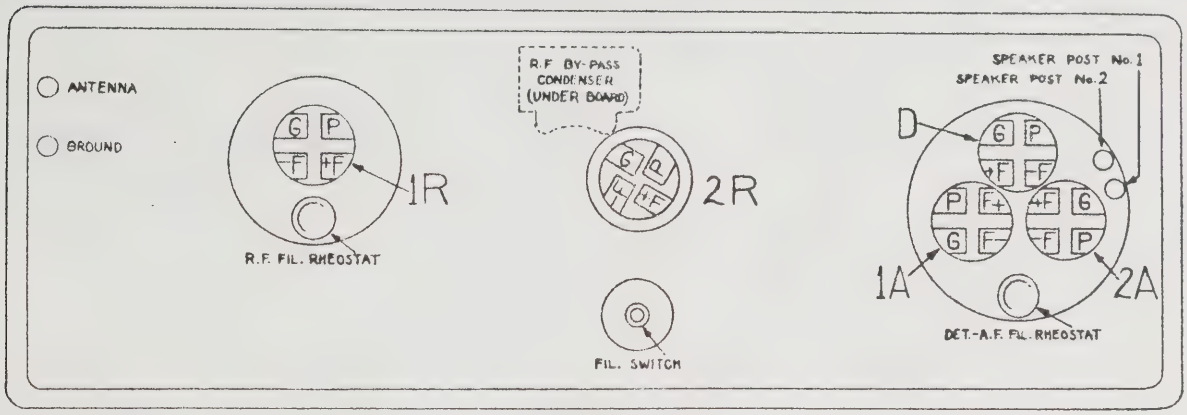


FIG. 30.

(For Following Tests, Place Filament Switch "On" and Rheostats Barely "On")

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
Each cable lead end to corresponding soldered connection under board.	*Full*	Open in cable.	Examine cable for broken leads and short circuits. Repair or replace cable if necessary.
BLACK to			
—F1R, —F2R	*Full*	Open R.F. filament rheostat or connection.	Examine joints under board.
—FD, —F1A, —F2A	*Full*	Open Detector-A.F. rheostat or connection.	Examine joints under board.
Ground Post.	*Full*	Open ground connection.	
Antenna Post.	*Full*	Open antenna coil or connection.	Test with ant. switch on each tap.
G1R	*Partial*	Open antenna coil or first grid resistance.	1st grid resis. located inside ant. coil.
P1R, P2R	*None*	No. 1, 2 R.F.T. primary circuit grounded.	Check transformer connections.
PD, P1A	*None*	No. 1, 2 A.F.T. primary circuit grounded.	Examine conn. in 3-tube container.
G2R	*Partial*	Open sec. No. 1 R.F.T. or 2nd grid res.	No. 2 grid res. inside No. 1 R.F.T.
G1A	*Partial*	None—Open secondary No. 1 A.F.T.	Full—Shorted secondary.
G2A	*Partial*	None—Open secondary No. 2 A.F.T.	Full—Shorted secondary.
RED to			
+F of each Socket.	*Full*	Open positive filament wire or connection.	Examine joints under board.
PD	*None*	Shorted phone condenser.	Located inside 3-tube container.
GD	*None*	Shorted grid condenser.	Located inside 3-tube container.
P1R	*None*	Shorted plate circuit by-pass condenser.	Located under board.
Ground Post.	*None*	Grounded positive filament circuit.	Inspect wir. for accidental grounds.
YELLOW to PD	*Partial*	None—Primary No. 1 A.F.T. open.	Full—Pri. No. 1 A.F.T. shorted.
BROWN to			
P1R	*Full*	Primary No. 1 R.F.T. open.	
P2R	*Full*	Primary No. 2 R.F.T open	
P1A	*Partial*	None—Primary No. 2 A.F.T. open.	Full—Pri. No. 2 A.F.T. shorted.
Speaker Post No. 2.	*Full*	Open connection.	
OTHER TESTS			
P2A to Spkr. Post No. 1.	*Full*	Open connection.	

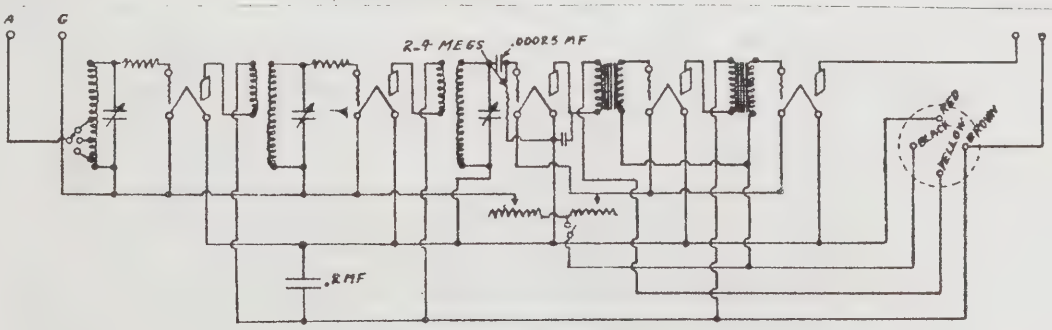


FIG. 31.

Model 12 Receiver—Test Chart, Continuity Table and Diagram

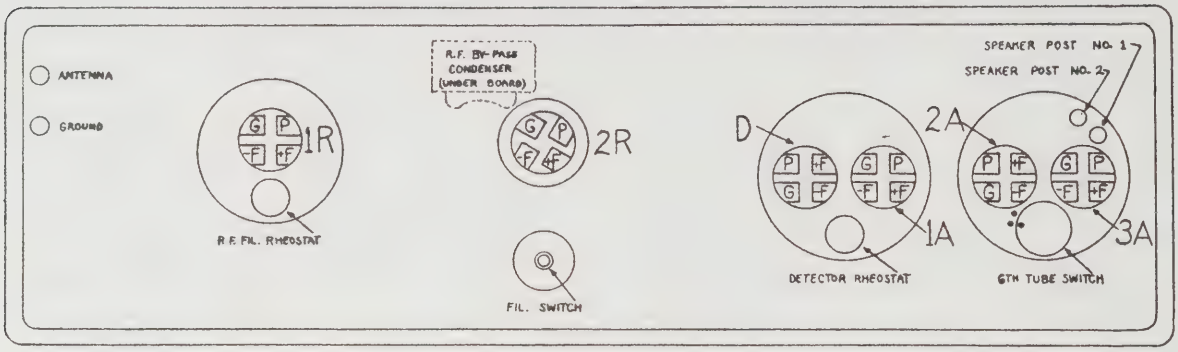


FIG. 32.

(For Following Tests, Place Filament Switch "On" and Rheostats Barely "On")

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
Each cable lead end to corresponding soldered end under board.	*Full*	Open in cable.	Examine cable for broken leads and short circuits. Repair or replace cable if necessary.
BLACK to			
—F1R, —F2R	*Full*	Open R.F. filament rheostat or connection.	Examine joints under board.
—FD, —F1A	*Full*	Open Det.-1st A.F. fil. rheo. or connection.	Examine joints under board.
—F2A, —F3A	*Full*	Open fixed resistance A.F. filament.	Located inside right hand container.
Ground Post.	*Full*	Open ground connection.	
Antenna Post.	*Full*	Open antenna coil or connection.	Test with ant. switch on each tap.
G1R	*Partial*	Open antenna coil or first grid resistance.	No. 1 grid resistance inside ant. coil.
P1R, P2R	*None*	No. 1, 2 R.F.T. primary circuit grounded.	Check transformer connections.
PD, P1A, P2A	*None*	No. 1, 2, 3 A.F.T. primary circuit grounded.	Examine conn. in 2-tube cases.
G2R	*Partial*	Open sec. No. 1 R.F.T. or No. 2 grid res.	No. 2 grid res. inside No. 1 R.F.T.
G1A, G2A, G3A	*Partial*	None—Open secondary No. 1, 2, 3 A.F.T.	Full—Shorted secondary.
RED to			
+F of R.F., Det., 1st and 2nd A.F.	*Full*	Open positive filament wire or connection.	Examine joints under board.
+F3A (6th Tube Switch to Rt.)	*Full*	Open wire or defective switch.	No reading with switch turned left.
PD	*None*	Shorted phone condenser.	Located inside Det.-1st A.F. case.
GD	*None*	Shorted grid condenser.	Located inside Det.-1st A.F. case.
P1R	*None*	Shorted R.F. plate circuit by-pass condenser.	Located under board.
YELLOW to			
PD	*Partial*	None—Open primary No. 1 A.F.T.	Full—Shorted primary.
BROWN to			
P1R	*Full*	Open primary No. 1 R.F.T.	
P2R	*Full*	Open primary No. 2 R.F.T.	
P1A	*Partial*	None—Open primary No. 2 A.F.T.	Full—Shorted primary.
P2A (6th Tube Switch to Rt.)	*Partial*	None—Open primary No. 3 A.F.T.	Full—Shorted primary (no reading with switch turned left.)
Speaker Post No. 2.	*Full*	Open connection.	

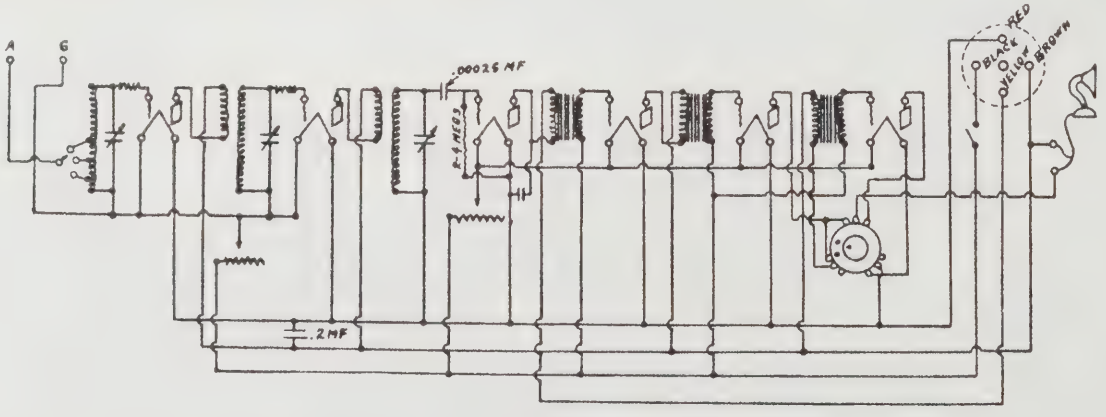


FIG. 33.
(Diagram shows one rheostat controlling detector and all three A.F. tubes. In actual set, rheostat controls detector and 1st audio only, 2nd and 3rd audio tubes being on separate fixed resistances.)

Model 20 No. 4640 Receiver—Test Chart, Continuity Table and Diagram

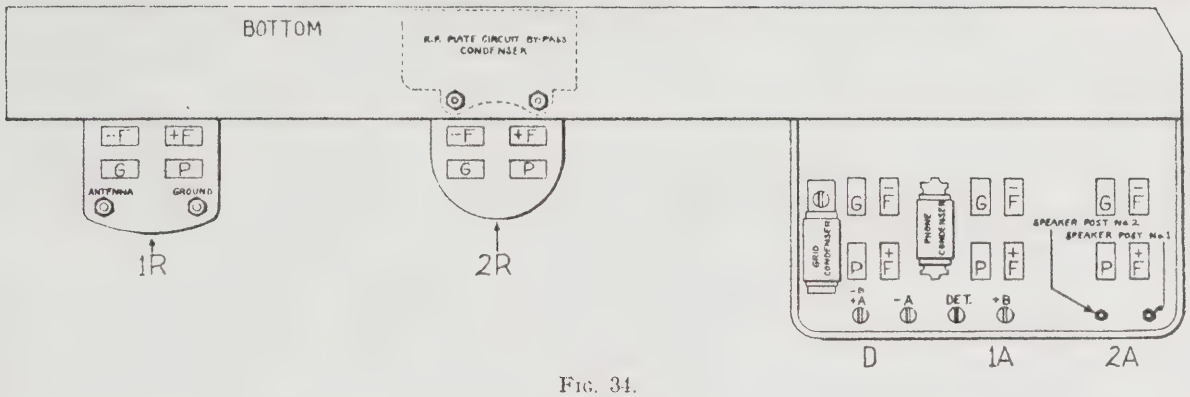


Fig. 34.

(For Following Tests, Place Filament Switch "On" and Rheostats Barely "On")

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
—A POST to			
—F1R, —F2R, Ground Post.	*Full*	Open in R.F. filament rheo. or connections.	
—FD, —F1A, —F2A	*Full*	Open in Det.-A.F. fil. rheo. or connections.	
Antenna Post.	*Full*	Open antenna coil or connection.	Test with antenna switch on each of 3 points.
+B Post.	*None*	Shorted R.F. by-pass condenser or grounded R.F.-1st A.F. plate circuit.	If necessary, unsolder by-pass condenser connection and test separately. Examine plate circuits for accidental grounds.
G1R	*Nearly Full*	Open antenna coil or first grid resistor.	Test sec. and grid res. separately. Grid resistors are mounted on back of R.F. var. condensers.
G2R	*Nearly Full*	Open secondary No. 1 R.F.T. or open second grid resistor.	Test sec. and grid res. separately. Grid resistors are mounted on back of R.F. var. condensers.
GD	*None*	Shorted detector grid condenser.	
G1A	*Partial*	None—Open secondary No. 1 A.F.T.	Full—Shorted secondary.
G2A	*Partial*	None—Open secondary No. 2 A.F.T.	Full—Shorted secondary.
Stator of Detector Variable Condenser.	*Full*	Open secondary No. 2 R.F.T.	
+A, —B POST to			
+F of All Sockets.	*Full*	Open positive filament circuit.	
PD	*None*	Shorted phone condenser.	
+20 (DET.) POST to			
PD	*Partial*	None—Open primary No. 1 A.F.T.	Full—Shorted primary.
+B POST to			
P1R	*Full*	Open primary No. 1 R.F.T.	
P2R	*Full*	Open primary No. 2 R.F.T.	
P1A	*Partial*	Open primary No. 2 A.F.T.	Full—Shorted primary.
Speaker Post No. 2.	*Full*	Open connection.	

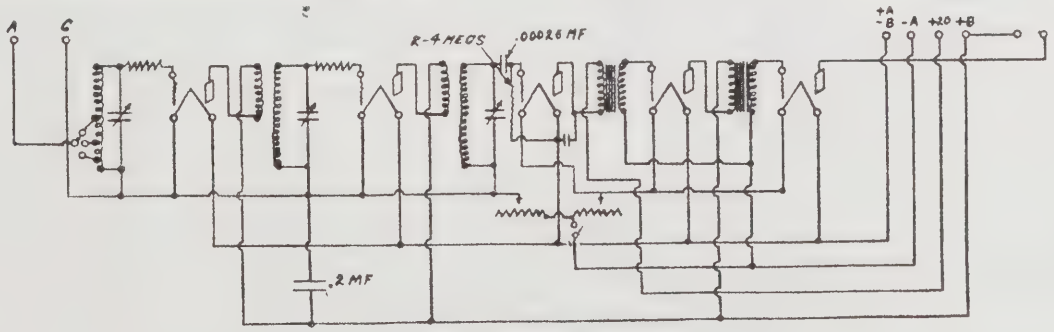


Fig. 35.

Model 20 Compact Receiver—Continuity Table

(For Following Tests, Place Filament Switch "On" and Rheostats Barely "On")

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
			NOTE: Examine cable for broken leads, broken connections and short circuits. Repair or replace cable if necessary.
BLACK to			
—F1R, —F2R, Ground Post.	*Full*	Open R.F. rheostat or connection.	R.F. rheostat at left.
—FD (7960 Set).	*Full*	Open detector rheostat or connection.	Detector rheostat at right.
—F1A, —F2A (7960 Set).	*Full*	Open A.F. filament fixed resistance.	Green insulated wire between rheotat assembly and —F1A.
—FD, —F1A, —F2A (7570 Set).	*Full*	Open Detector-A.F. filament rheostat or connection.	Detector-A.F. rheostat at right.
+FD (7960 Set).	*Nearly Full*	Open detector grid bias resistance.	
Antenna Post.	*Full*	Open primary antenna transformer or defective tap switch.	Test with antenna switch on each of 3 taps.
G1R	*Partial*	Open secondary antenna transformer or open first grid resistance.	Test secondary and grid resistor separately. Grid resistors mounted on back of R.F. variable condensers.
P1R, P2R	*None*	No. 1, 2 R.F.T. primary circuit grounded.	Or shorted by-pass condenser. (Unsolder lead and test condenser separately.)
PD	*None*	No. 1 A.F.T. primary circuit grounded.	Or shorted phone condenser (on 7960 set).
P1A	*None*	No. 2 A.F.T. windings grounded.	Examine transformer connections.
G2R	*Partial*	None—Open secondary No. 1 R.F.T. or open grid resistor.	Full—Shorted grid circuit or shorted grid resistor.
GD	*None*	Shorted grid condenser.	Mounted on det. var. condenser.
G1A (7960 Set).	*Partial*	None—Open secondary No. 1 A.F.T.	Full—Shorted secondary.
Stator of Detector Variable Condenser.	*Full*	Open secondary No. 2 R.F.T.	
RED to			
+F of All Sockets.	*Full*	Open positive filament circuit.	
PD (7570 Set).	*None*	Shorted phone condenser.	
WHITE to			
P1R	*Full*	Open primary No. 1 R.F.T.	
P2R	*Full*	Open primary No. 2 R.F.T.	
P1A (7960 Set).	*Partial*	None—Open primary No. 2 A.F.T.	Full—Shorted primary.
YELLOW to			
PD	*Partial*	None—Open primary No. 1 A. F. T.	Full—Shorted primary.
BROWN to			
Speaker Post No. 2.	*Full*	Open cable lead or connection.	
P1A (7570 Set).	*Partial*	None—Open primary No. 2 A.F.T.	Full—Shorted primary.
OTHER TESTS			
P2A to Speaker Post No. 1.	*Full*	Open connection.	
—C Lead to G2A	*Partial*	None—Open secondary No. 2 A.F.T.	Full—Shorted secondary.
—C Lead to G1A (on 7570 Set).	*Partial*	None—Open secondary No. 1 A.F.T.	Full—Shorted secondary.

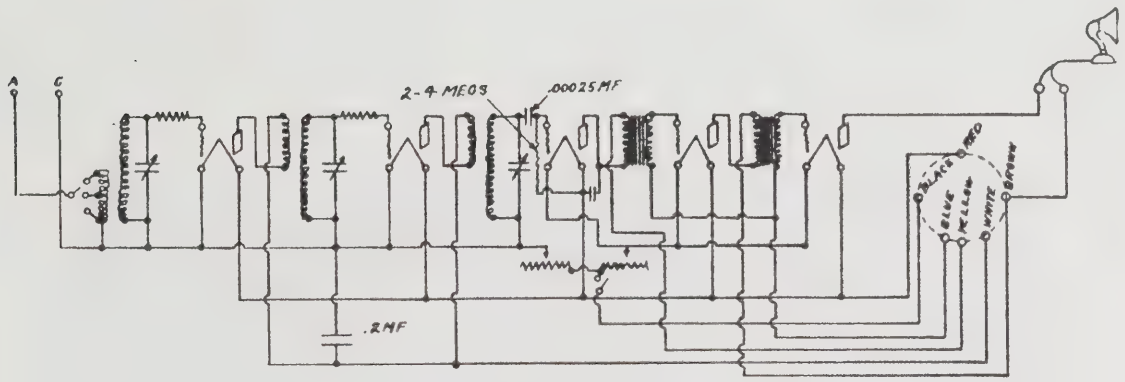


FIG. 36. MODEL 20 COMPACT SET NO. 7570. WIRING DIAGRAM.

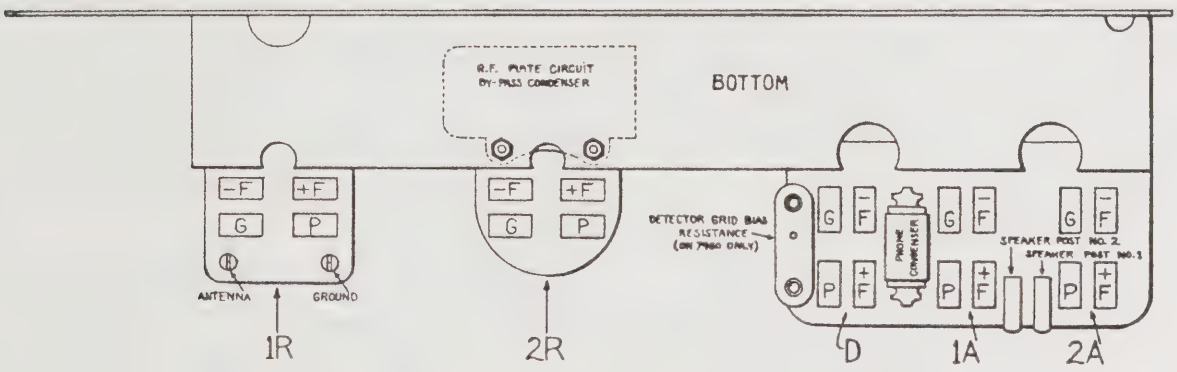


FIG. 37. TESTING CHART FOR MODEL 20 COMPACT (BOTH TYPES).

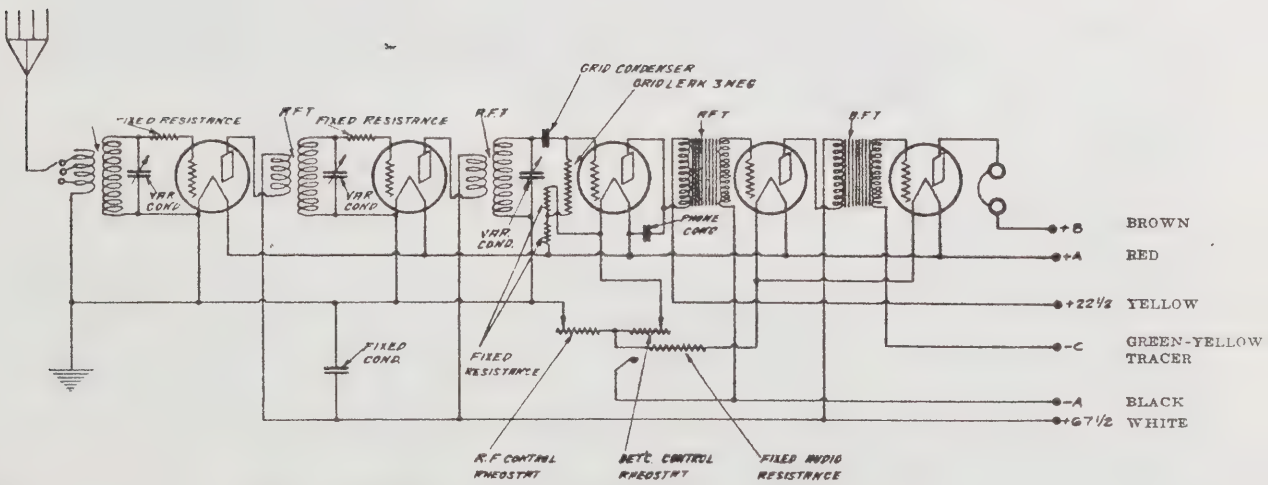


FIG. 38. MODEL 20 COMPACT SET NO. 7960. WIRING DIAGRAM.

Models 30, 35 and 48 Receiving Sets

General Description

The circuits of Models 30, 35 and 48 receivers are practically identical. Each has six tubes and single dial control. There are three stages of radio frequency amplification, a tuned detector, and two stages of audio frequency amplification. The first R. F. stage is untuned, being used as an antenna coupling tube for the purpose of eliminating the effect of different sizes of antenna systems on the synchronism of the three tuned circuits.

In Models 30 and 48 one rheostat controls the filaments of the three R. F. tubes, and another rheostat controls the detector filament. A fixed resistance is connected in series with the filaments of the two A. F. tubes.

In Model 35 one rheostat controls the three R. F. filaments and a fixed resistance is connected in series with the filaments of the detector and two A. F. tubes.

Model 30 (Early Type) has moulded end-plate variable condensers and three separate sockets for the R. F. tubes. Model 30 (Later Type) has metal frame variable condensers and a single moulded base for the three R. F. sockets.

Model 48 is similar to the later Model 30, but has a gold-finished panel and other minor refinements.

The chassis of Model 35 is similar in appearance to the later Model 30 and to Model 48, but it is mounted inverted inside a metal cabinet that is open on the bottom.

1. Model 35. Removing Chassis from Cabinet

Remove dial and vernier knob. Unscrew six bolts holding bottom rim to cabinet and remove rim. Remove six screws, three in a row at each end of the vertical side of metal frame. (Use magnetized screw driver.)

With top of cabinet on table, pull chassis back slightly to clear condenser shaft and rheostat knob, then lift set up and out, tilting chassis so the filament switch knob is inclined away from the table in order that the switch knob will clear the cabinet.

2. Model 30 (Later Type) and Model 48. Removing Chassis from Panel

Remove dial and vernier knob. Remove six screws, three in a row at each end of vertical side of metal frame. The panel may then be removed.

3. Model 30 (Early Type). Replacing Sub-Panel Assembly

Remove set from cabinet. Remove dial and vernier knob. Unsolder leads from sub-panel assembly. Remove three screws in front panel at center variable condenser and four screws along the bottom. It is necessary to remove bolts on the third R. F. socket and remove fixed by-pass condenser in order to change the sub-panel assembly. (If the by-pass condenser is of old style—brown color—replace with No. 8685.) Remove sub-panel assembly.

Attach the replacement sub-panel assembly, without tightening screws, and replace the fixed condenser, which is held by the two bolts passing through the third R. F. socket. The edge of the by-pass condenser must not be caught under the bottom angle of the sub-panel frame. Tighten screws holding sub-panel, solder connections exactly as the original, assemble set, and synchronize condensers. (See Section XI.)

4. Replacing Condenser Group in Models 30 (Later Type), 35 and 48

Remove chassis from cabinet or panel. Loosen nine screws holding condensers to front of metal frame. Note how pulleys and belts are arranged and then remove them. Replace one condenser at a time. Do not mix old condensers with the replacements.

Remove two nuts on back of first variable condenser, which clamp grid resistor (grid condenser on third variable condenser) and lug of secondary lead. Remove three screws holding condenser to chassis and lift out the condenser.

Put in the replacement condenser and its three screws, without tightening screws. Attach grid resistor and lug of secondary lead to top and bottom bolts respectively on back of condenser. Repeat procedure with other two variable condensers. When the replacement condensers are installed, put on the pulleys and belts, adjust belt tension and synchronize condensers. (See Section XI.)

5. Replacing R. F. Amplifier Assembly in Models 30 (Later Type), 35 and 48

Remove chassis from cabinet or panel. The R. F. amplifier assembly consists of three R. F. transformers mounted on a moulded three-socket base. The filament contacts are wired and have two leads for connection to rest of set; the plate circuits are wired and have one lead for connection to the +B, R. F. (white) cable lead. A lead from the grid-end of each R. F. transformer secondary is soldered to a lug which is to be fastened to the bottom bolt on back of the variable condenser in front of each R. F. transformer.

In replacing R. F. amplifier assembly, remove the old assembly by unsoldering the R. F. by-pass condenser lead, lead from grid of first R. F. socket, leads from grid resistors (unsolder at grid contacts of socket), two filament circuit leads (at points where they connect to rest of set), and the +B, R. F. lead. Remove secondary wire lug from bottom bolt on each variable condenser. Unsolder, at grid contact of detector socket, the lead from grid condenser, which passes through a hole in the R. F. base. Unsolder lead from ground lug to negative side of R. F. filament circuit. Remove five bolts holding R. F. base to metal chassis and remove the old R. F. amplifier assembly.

Reassemble with replacement R. F. amplifier, reversing above procedure.

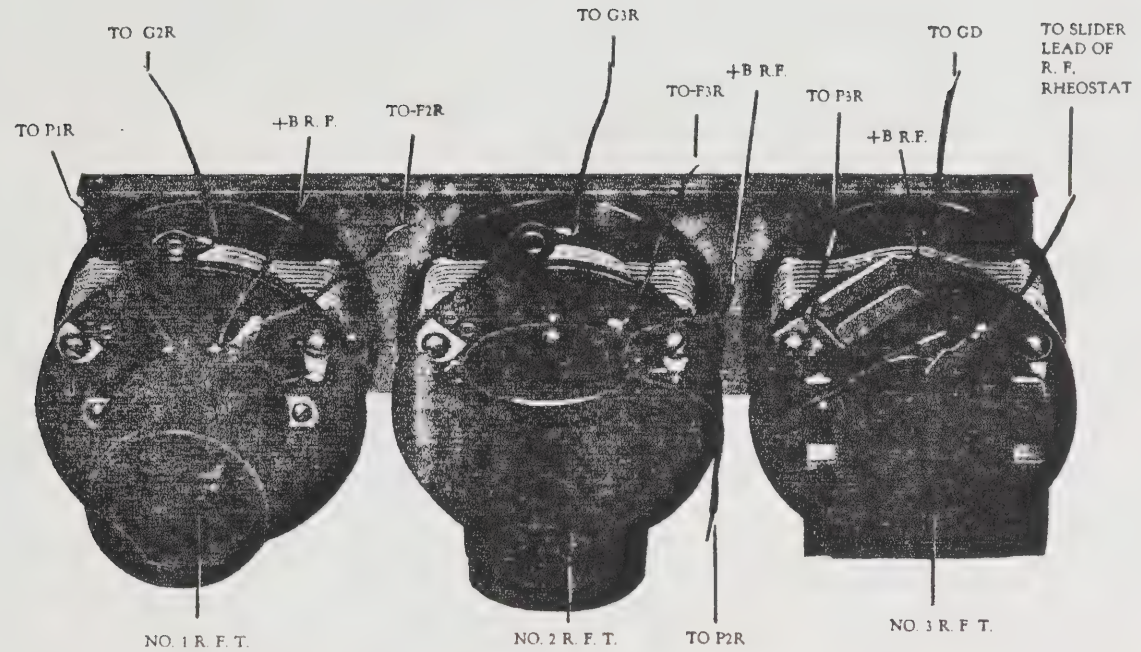


FIG. 39. VIEW OF SUB-PANEL ASSEMBLY MODEL 30 (Early Type), SHOWING WHERE EACH LEAD IS TO BE CONNECTED.

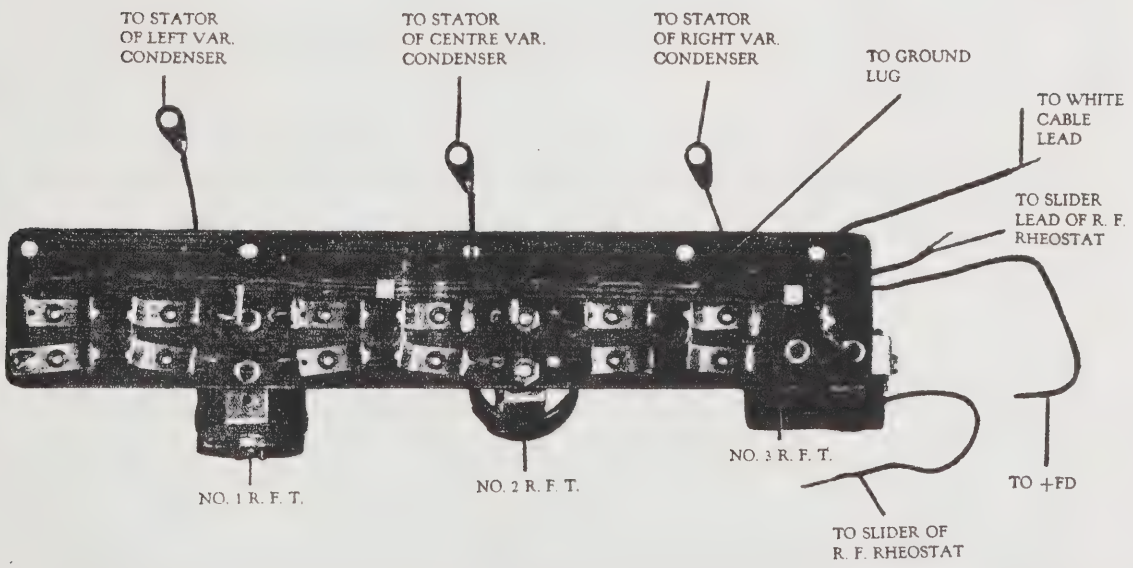


FIG. 40. VIEW OF R.F. AMPLIFIER ASSEMBLY IN MODELS 30 (Later Type), 35 AND 48, SHOWING WHERE EACH LEAD IS TO BE CONNECTED.

Replacing R. F. Transformers, Variable Condensers or Grid Resistors in Models 30, 35 and 48

MODEL OF SET	If One R. F. Transformer is Defective	If One Variable Condenser is Defective	If One Grid Resistor is Defective
MODEL 30 (with moulded end-plate condensers)	Replace Sub-panel Assembly No. 8,185. This consists of a metal frame, three variable condensers, three R. F. transformers, two grid resistors, and one grid condenser, all mounted in place, with pulleys and belts adjusted.	Replace Sub-panel Assembly No. 8,185.	Replace defective resistor No. 8,092.
MODEL 30 (with metal frame condensers)	Replace R. F. Amplifier Assembly No. 8,449 for sets between Serial Nos. 636,101 and 639,358. No. 9,030 for sets above Serial No. 644,351.	Replace group (No. 9,100) of three variable condensers. Use pulleys and belts of original group.	Replace defective resistor No. 8,439.
MODEL 35	Replace R. F. Amplifier Assembly No. 8,108 for sets previous to Serial No. 900,000. No. 8,440 for sets between Serial Nos. 900,000 and 955,700. No. 9,020 for sets after Serial No. 955,700.	Replace group of three variable condensers. No. 9,201 (13 plates) for sets previous to Serial No. 900,000. No. 9,100 (17 plates) for sets after Serial No. 900,000. Use pulleys and belts of original group.	Replace defective resistor No. 8,225 for sets previous to Serial No. 900,000. No. 8,439 for sets after Serial No. 900,000.
MODEL 48	Replace R. F. Amplifier Assembly No. 9,030.	Replace group of three variable condensers. No. 9,100. Use pulleys and belts of original group.	Replace defective resistor No. 8,439.

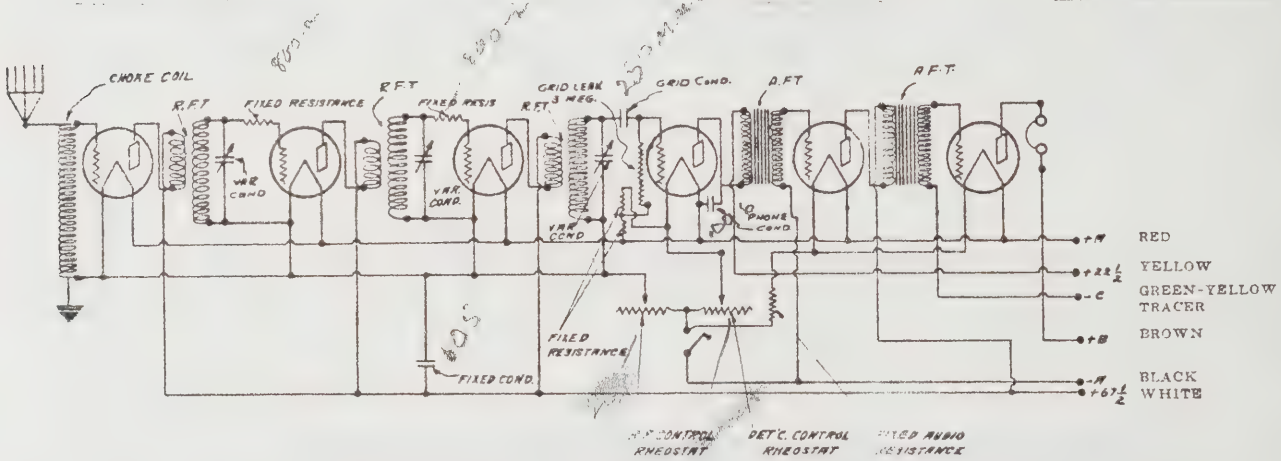


FIG. 41. WIRING DIAGRAM OF MODELS 30, 35 AND 48. (In Model 35, one rheostat controls the three R.F. filaments and a fixed resistance is connected in series with the detector and two A.F. filaments.)

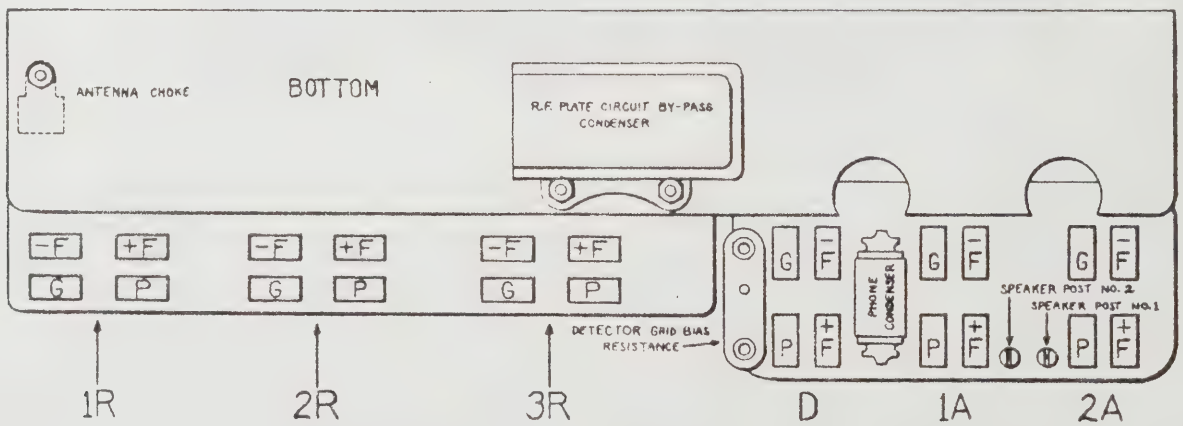


FIG. 42. TEST CHART FOR MODELS 30, 35 AND 48.

NOTE.—Early Model 30 Sets have separate R.F. sockets, but the socket contacts are in same relative position as shown in above chart.

Continuity Test Table—Models 30, 35 and 48

(For Following Tests, Place Filament Switch "On" and Rheostats Barely "On")

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
			Examine cable for open leads, broken connections and short circuits. Repair or replace cable if necessary.
BLACK to			
—F of R.F. Sockets.	*Full*	Open R.F. filament rheo. or connections.	R.F. filament rheostat at left (on Models 30 and 48).
—F of A.F. Sockets.	*Full*	Open A.F. fil. fixed resis. or connections.	Green insulated wire from rheostat assembly to —F1A.
—FD	*Full*	Open detector filament rheostat or connections. (Models 30 and 48.)	Or open connection to det.-A.F. fil. fixed resis. (Model 35).
Ground Post.	*Full*	Open connection.	
Antenna Post.	*Full*	Open antenna choke coil or connection.	
G1R	*Full*	Open connection.	
P of R. F. Sockets.	*None*	No. 1, 2, 3 R.F.T. primary circuit grounded.	Or shorted R.F. plate circuit bypass condenser. (Unsolder lead and test condenser separately.)
PD	*None*	No. 1 A.F.T. primary circuit grounded.	Or shorted phone condenser. (Unsolder lead and test condenser separately.)
P1A	*None*	No. 2 A.F.T. primary circuit grounded.	Inspect transformer connections.
G2R	*Partial*	None—Open secondary No. 1 R.F.T. or open grid resistor.	Full—Shorted grid resistor.
G3R	*Partial*	None—Open secondary No. 2 R.F.T. or open grid resistor.	Full—Shorted grid resistor.
GD	*None*	Shorted detector grid condenser.	Mounted on back of last var. cond.
G1A	*Partial*	None—Open secondary No. 1 A.F.T.	Full—Shorted secondary.
Stator of Detector Variable Condenser.	*Full*	Open secondary No. 3 R.F.T.	
RED to			
+F of All Sockets.	*Full*	Open positive filament circuit.	
Black	*Nearly Full*	None—Open detector grid bias resistance.	Full—Shorted bias resistor or grounded +F circuit.
WHITE to			
P of R.F. Sockets.	*Full*	Open primary No. 1, 2, 3 R.F.T.	
P1A	*Partial*	Open primary No. 1 A.F.T.	Full—Shorted primary.
YELLOW to			
PD	*Partial*	None—Open primary No. 1 A.F.T.	Full—Shorted primary.
BROWN to			
Speaker Post No. 2.	*Full*	Open connection.	
OTHER TESTS			
—C Lead (Green-Yellow Tracer) to G1A	*Partial*	None—Open secondary No. 2 A.F.T.	Full—Shorted secondary.
P2A to Speaker Post No. 1.	*Full*	Open connection	

Model 32 Receiving Set

General Description

The Model 32 is a seven-tube, single dial, battery type receiver, having four stages of radio frequency amplification, a tuned detector, and two stages of audio frequency amplification. The first R. F. amplifying tube is not tuned, being used as an antenna coupling tube for the purpose of preventing different sizes of antenna from disturbing the synchronism of the succeeding tuned circuits.

The filaments of the R. F. tubes are controlled by one rheostat. Another rheostat controls the detector filament, and a fixed resistance is connected in series with the two A. F. filaments.

The Model 32 may be recognized by its four double R. F. transformers and four moulded end-plate variable condensers.

Replacing Sub-Panel Assembly No. 8296

If one of the R. F. transformers or one of the variable condensers is defective, the entire sub-panel assembly must be replaced. This assembly consists of a metal frame, four moulded end-plate variable condensers, four double R. F. transformers, three grid resistors and a detector grid condenser, all mounted in place with pulleys and belts adjusted.

Remove dial and vernier knob. Unsolder leads from sub-panel assembly. Remove three screws in front panel at second variable condenser and five screws along the bottom. Remove two bolts holding fourth R. F. socket and remove by-pass condenser. (If by-pass condenser is of old style—brown color—replace with No. 8685.) Lift out old assembly.

Screw the replacement sub-panel assembly into position, without tightening screws, and replace the by-pass condenser, which is held by two bolts passing through the fourth R. F. socket. The edge of the condenser must not be caught under the bottom angle of the sub-panel frame. Tighten screws holding sub-panel. Solder connections exactly like original, assemble set and synchronize condensers. (See Section XI.)

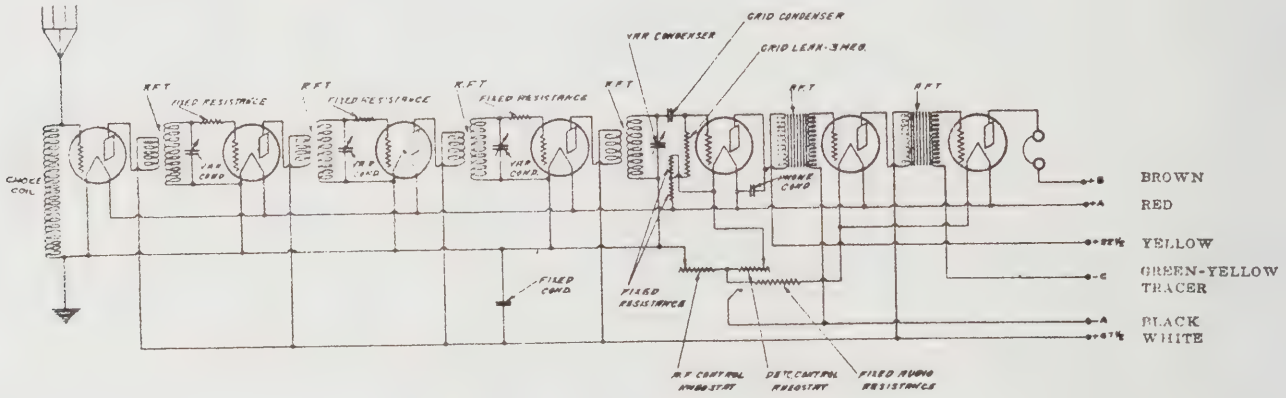


Fig. 43. Wiring Diagram of Model 32.

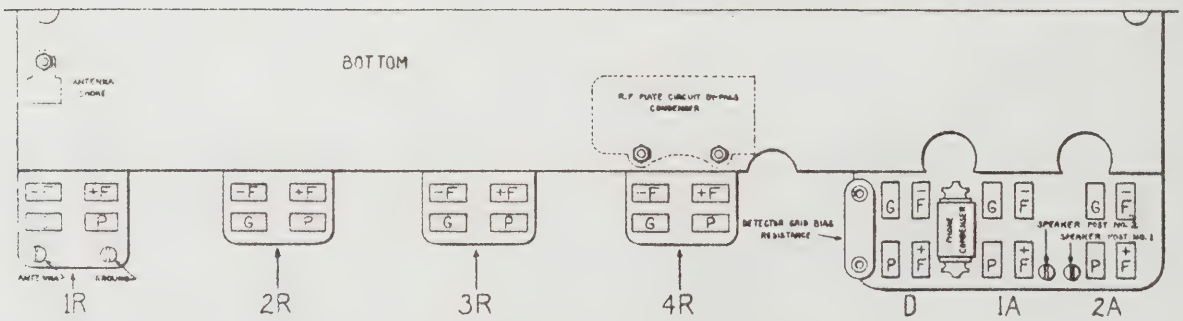


Fig. 44. Testing Chart for Model 32.

Continuity Test Table—Model 32

(For Following Tests, Place Filament Switch "On" and Rheostats Barely "On")

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
			Examine cable for broken leads or short circuits. Repair or replace cable if necessary.
BLACK to			
—F of R.F. Sockets.	*Full*	Open in cable, connection, or R.F. rheo.	R.F. rheostat at left.
—FD	*Full*	Open connection or detector rheostat.	Detector rheostat at right.
—F of A.F. Sockets.	*Full*	Open connection or A.F. fil. fixed resistance.	A.F. resistance—green insulated wire from rheostat assembly to —F1A.
Ground Post.	*Full*	Open ground connection.	
Antenna Post.	*Full*	Open antenna choke coil or connection.	
G1R	*Full*	Open connection.	
P1R, P2R, P3R, P4R	*None*	No. 1, 2, 3, 4 R.F.T. pri. circuit grounded.	Or shorted R.F. by-pass condenser.
PD	*None*	No. 1 A.F.T. primary circuit grounded.	Or shorted phone condenser.
P1A	*None*	No. 2 A.F.T. primary circuit grounded	
Red	*Nearly Full*	None—Open detector grid bias resistance.	Full—Shorted bias or grounded positive filament circuit.
G2R, G3R, G4R	*Nearly Full*	None—Open secondary No. 1, 2, 3 R.F.T. or open No. 1, 2, 3 grid resistance.	Full—Shorted grid resistor. (Resistors mounted on back of R.F. variable condensers).
Stator of Detector Variable Condenser.	*Full*	Open secondary No. 4 R.F.T.	
G1A	*Partial*	None—Open secondary No. 1 A.F.T.	Full—Shorted secondary.
RED to			
+F of All Sockets.	*Full*	Open in cable or connection.	
WHITE to			
Plate of Each R.F. Socket.	*Full*	Open primary No. 1, 2, 3, 4 R.F.T.	
P1A	*Partial*	None—Open primary No. 2 A.F.T.	Full—Shorted primary.
YELLOW to			
PD	*Partial*	None—Open primary No. 1 A.F.T.	Full—Shorted primary.
BROWN to			
Speaker Post No. 2.	*Full*	Open in cable or connection.	
OTHER TESTS			
P2A to Speaker Post No. 1.	*Full*	Open connection.	
Green-Yellow Tracer to G2A	*Partial*	None—Open secondary No. 2 A.F.T.	Full—Shorted secondary.

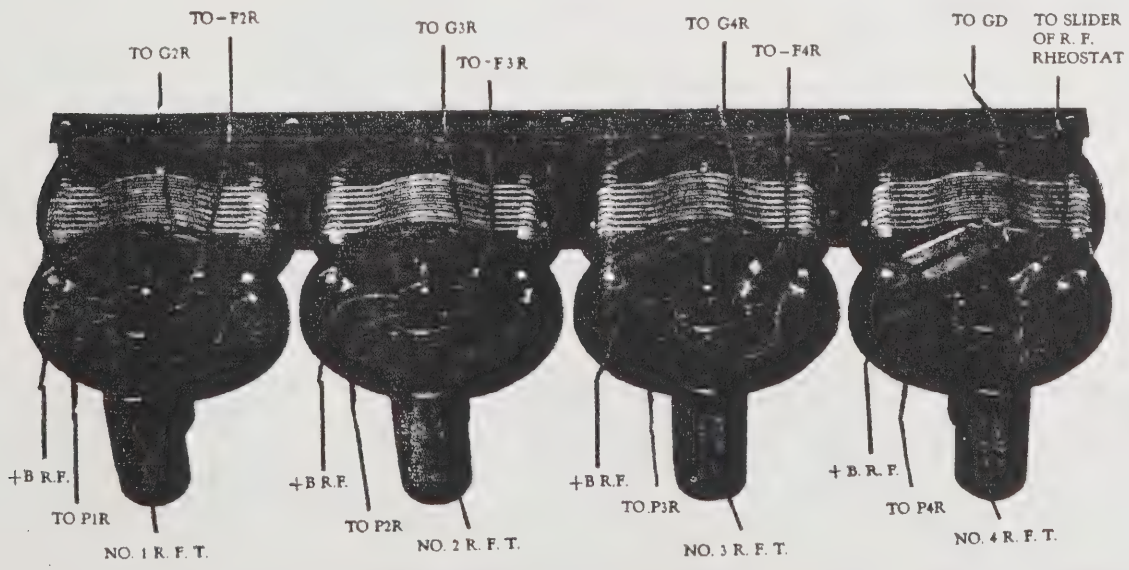


FIG. 45. VIEW OF SUB-PANEL ASSEMBLY MODEL 32, SHOWING WHERE EACH LEAD IS TO BE CONNECTED.

General Description

The Model 33 is a six-tube, single-dial, battery-type receiver, having three stages of tuned radio frequency amplification, a tuned detector, and two stages of audio frequency amplification. The first variable condenser, tuning the secondary of the antenna transformer, has an extra independently variable plate controlled by a small knob at the left (antenna adjustment knob). This compensates for different size of antenna and makes it possible to maintain synchronism between this circuit and the other three tuned circuits.

The three R. F. filaments are controlled by one rheostat, the detector filament by another rheostat, and a fixed resistance is connected in series with the two A. F. filaments.

Model 49 is similar to Model 33, but has a gold-finished panel.

Removing Chassis from Panel—Loosen set screws in antenna adjustment knob and in the tuning dial. Remove vernier knob, tuning dial, and antenna adjustment knob. Remove six screws, three in a row at each end of the vertical side of the metal frame. Remove one screw near the center of the vertical side of metal frame. The panel may then be lifted clear of the chassis, taking care not to break the connections from rheostat assembly. (In removing set from cabinet it is sometimes necessary to slide the set out toward the left in order that the by-pass condenser will come at a place where the bottom wood strip, which holds panel screws, is cut away.)

Replacing Variable Condensers

If one of the variable condensers is defective, replace entire group of four. Part No. 9190. Use pulleys and belts of original group.

Procedure: Loosen twelve screws holding variable condensers to metal frame. Note how pulleys and belts are arranged and then remove them. Replace one condenser at a time. Do not mix up the old condensers with the replacements.

Remove the double R. F. transformers which are mounted on backs of variable condensers (do not unsolder transformer leads), at the same time removing the grid resistors, the grid condenser and the lugs of secondary leads, which are held to the condensers by the same nuts that hold the R. F. transformer brackets.

Remove the three screws holding first condenser, lift out the condenser and put in replacement without tightening screws. Mount the first R. F. transformer, the first grid resistor and the secondary lead lug, on the two bolts on back of the condenser. Make certain that the axes or long sides of the transformer coils are vertical. This may be checked by seeing that the sides of coils are parallel to the vertical metal strip on the back of the condenser. (Continued on page 40.)

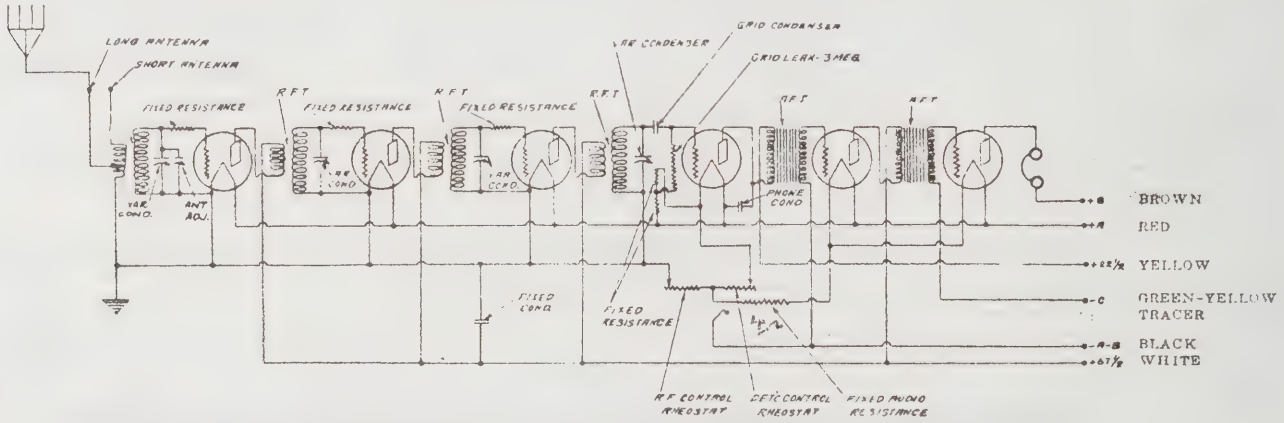


FIG. 46. WIRING DIAGRAM—MODELS 33 AND 49.

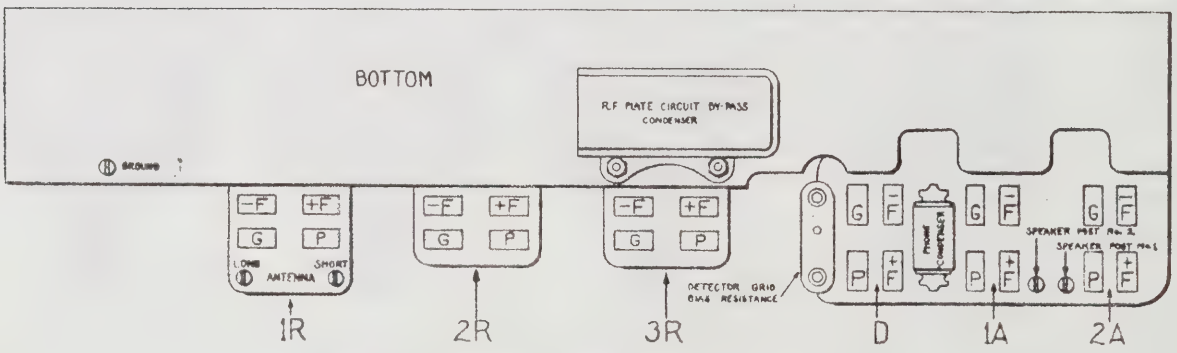


FIG. 47. TESTING CHART—MODELS 33 AND 49.

Continuity Test Table—Models 33 and 49

(For Following Tests, Place Filament Switch "On" and Rheostats Barely "On")

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
			Examine cable for open leads, broken connections and short circuits. Repair or replace cable if necessary.
BLACK to			
—F of R.F. Sockets.	*Full*	Open R.F. filament rheostat or connection.	R.F. rheostat at left.
—F of A.F. Sockets.	*Full*	Open A.F. fil. fixed resis. or wiring.	Fixed A.F. filament resistance is green insulated wire between rheo. assembly and —F1A.
—FD	*Full*	Open detector rheostat or connection.	Detector rheostat at right.
Ground Post.	*Full*	Open connection.	
Each Antenna Post.	*Full*	Open primary of antenna transformer.	
G1R	*Partial*	None—Open secondary antenna transformer or open grid resistor.	Full—Shorted grid circuit or shorted grid resistor.
P1R, P2R, P3R	*None*	No. 1, 2, 3 R.F.T. primary circuit grounded.	Or shorted R.F. plate circuit by-pass condenser. (Unsolder condenser lead and test condenser separately.)
PD	*None*	No. 1 A.F.T. primary circuit grounded.	Or shorted phone condenser. (Unsolder condenser lead and test condenser separately.)
P1A	*None*	No. 2 A.F.T. primary circuit grounded.	Inspect transformer connections.
G2R	*Partial*	None—Open secondary No. 1 R.F.T. or open grid resistor.	Full—Shorted grid circuit or shorted grid resistor.
G3R	*Partial*	None—Open secondary No. 2 R.F.T. or open grid resistor.	Full—Shorted secondary circuit or grid resistor.
G1A	*Partial*	None—Open secondary No. 1 A.F.T.	Full—Shorted secondary.
Stator of Detector Variable Condenser.	*Full*	Open secondary of last (No. 3) R.F.T.	
RED to			
+F of All Sockets.	*Full*	Open positive filament circuit.	
Black.	*Nearly Full*	None—Open detector grid bias resistance.	Full—Shorted bias resistance or grounded +F circuit.
WHITE to			
P of R.F. Sockets.	*Full*	Open primary No. 1, 2, 3 R.F.T.	
P1A	*Partial*	None—Open primary No. 2 A.F.T.	Full—Shorted primary.
YELLOW to			
PD	*Partial*	None—Open primary No. 1 A.F.T.	Full—Shorted primary.
BROWN to			
Speaker Post No. 2.	*Full*	Open cable lead or connection.	
OTHER TESTS			
P2A to Speaker Post No. 1.	*Full*	Open connection.	
—C Lead Green-Yellow Tracer to G2A	*Partial*	None—Open secondary No. 2 A.F.T.	Full—Shorted secondary.

Repeat procedure with each condenser and when all four are in place, put on the pulleys and belts, adjust belt tension and synchronize condensers. (See Section XI.)

Replacing R. F. Transformers

If one of the double R. F. transformers is defective, replace entire group of four. Part No. 9220.

In replacing double R. F. transformers, substitute one transformer at a time, mounting and connecting the replacement exactly like the original. Do not mix up the old coils with the replacements. Remove two nuts on back of first variable condenser which hold R. F. transformer brackets, unsolder transformer connections and remove old transformer. Put replacement transformer in position, seeing that the grid resistor and lug of secondary lead are replaced properly, and tighten the two nuts. The transformer angle brackets must be arranged so that the axis or long sides of the coil are vertical. This may be checked by seeing that the long sides of the coils are parallel to the vertical metal strip on the back of the variable condenser. Solder leads exactly like the original. Repeat procedure with each R. F. transformer.

The antenna transformer may be identified by its five leads; other R. F. transformers have four leads.

No. 1 R. F. T. has one green lead.
No. 2 R. F. T. has one yellow lead.
No. 3 R. F. T. has one blue lead.

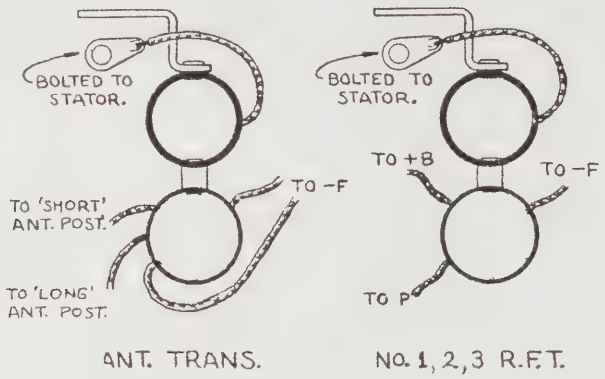


Fig. 48. Sketch Showing How Leads From Antenna Transformer and From R.F. Transformers Are To Be Connected.

Model 50 Set

General Description

The Model 50 employs seven tubes, having four stages of radio frequency amplification, a detector, and two stages of audio frequency amplification. The four stages of radio frequency are not tuned, the R. F. transformers being of a special air-core design, which covers the entire wave-length band efficiently. These transformers therefore do not have variable condensers connected across their secondaries.

A special method of tuning is used to couple the antenna circuit to the grid circuit of the first R. F. stage. This consists of a series or cascade of three tuned circuits loosely coupled together, tuned by three condensers geared together by belts similar to those used in the tuned R. F. sets. (See schematic diagram.)

The distance between the three tuning coils and the angle at which they are suspended relatively to each other, is worked out to give a selective filter between antenna and the first R. F. stage. As in the Model 33, two posts are provided for connection to the antenna coil, and one plate of the condenser across the secondary of the antenna circuit is separately adjustable, in order to compensate for different antenna lengths which may be used.

The selected signal which is tuned in by the station dial is passed through the four R. F. stages where it is amplified to considerable volume before reaching the detector. The detector and audio portion of this set is practically the same as in other Atwater Kent receivers.

In order to obtain selectivity and stability of operation, the various R. F. sections of the set (tuning stage, first and second R. F. stages, third and fourth R. F. stages and detector), are separately encased in grounded metal containers, and the entire set is enclosed in a single grounded metal housing that fits in the mahogany cabinet.

This shielding helps prevent interaction between the fields of the various coils, but its main purpose is to prevent any signal from outside entering the amplifying stages direct, without having passed through the antenna tuning system. The elimination of undesired signals is thereby readily obtained, and external "pick-up" reduced to a minimum. Pick-up of signals by the battery cable is eliminated by a by-pass condenser connected across the "A" battery circuit at the upper end of cable, and and by a choke-coil in the R. F. positive "B" voltage lead, the terminals of this choke being shunted to the ground by two additional by-pass condensers. (See schematic diagram, Fig. 50.)

One rheostat (left-hand knob) controls the filaments of the four R. F. tubes, a separate rheostat (right-hand knob) controls the detector filament, and a fixed resistor is connected in series with the filaments of the two A. F. tubes.

Removing Set from Mahogany Cabinet

Remove set from wood cabinet by taking out four round-head wood screws which hold bottom of metal case to the wood cabinet. Then take wood screws out of front panel, and slide metal case out of cabinet.

Removing Set from Metal Case

Remove the fourteen filister-head screws along bottom and sides and one screw at center top which hold the set to the metal case. The set, with its attached cable, may then be slid out of the metal case.

Testing Model 50

The continuity tests may be applied to Model 50 set without removing the set from its mahogany cabinet. The test prongs (in the voltmeter-battery testing circuit) should be long and sufficiently narrow at the pointed ends to fit down through the socket holes and make connection with the socket contacts. A test table and photographic chart for the Model 50 appear on the following pages.

Replacements

After applying the continuity tests and determining the source of trouble, the set may be removed from its metal case and repaired. In making replacements, first carefully study the manner in which the defective material is mounted and connected, then substitute the replacement, mounting and connecting it in exactly the same way as the original.

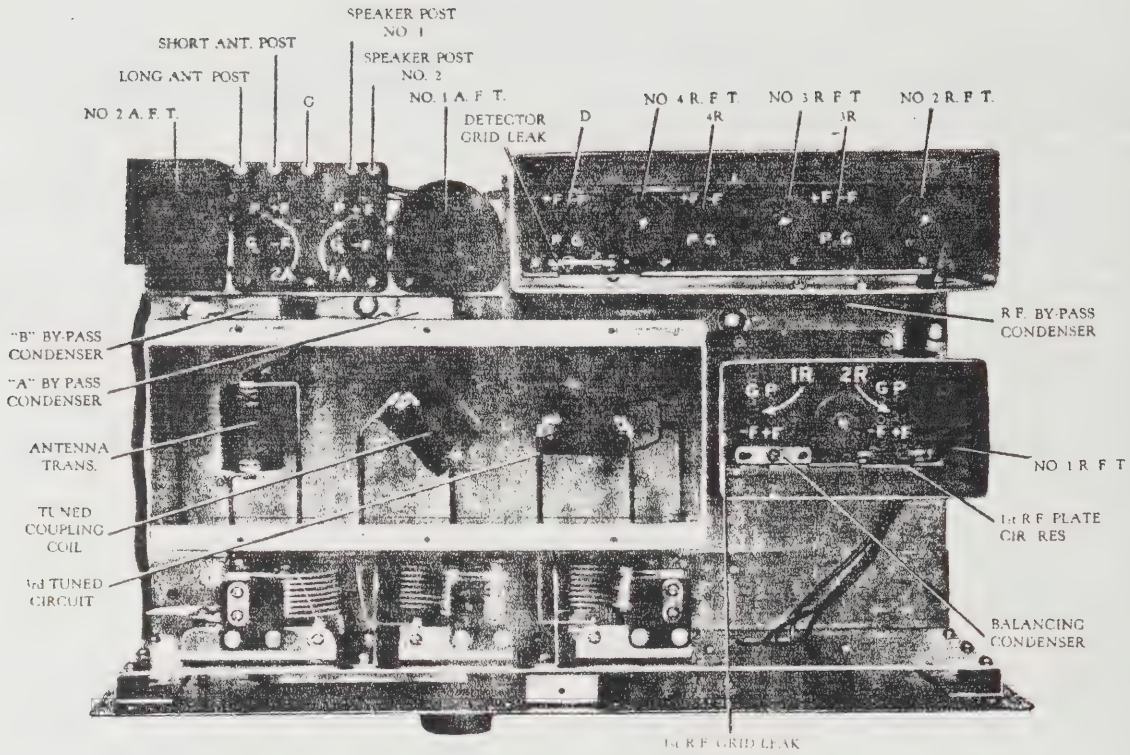


FIG. 49. TESTING CHART FOR MODEL 50.

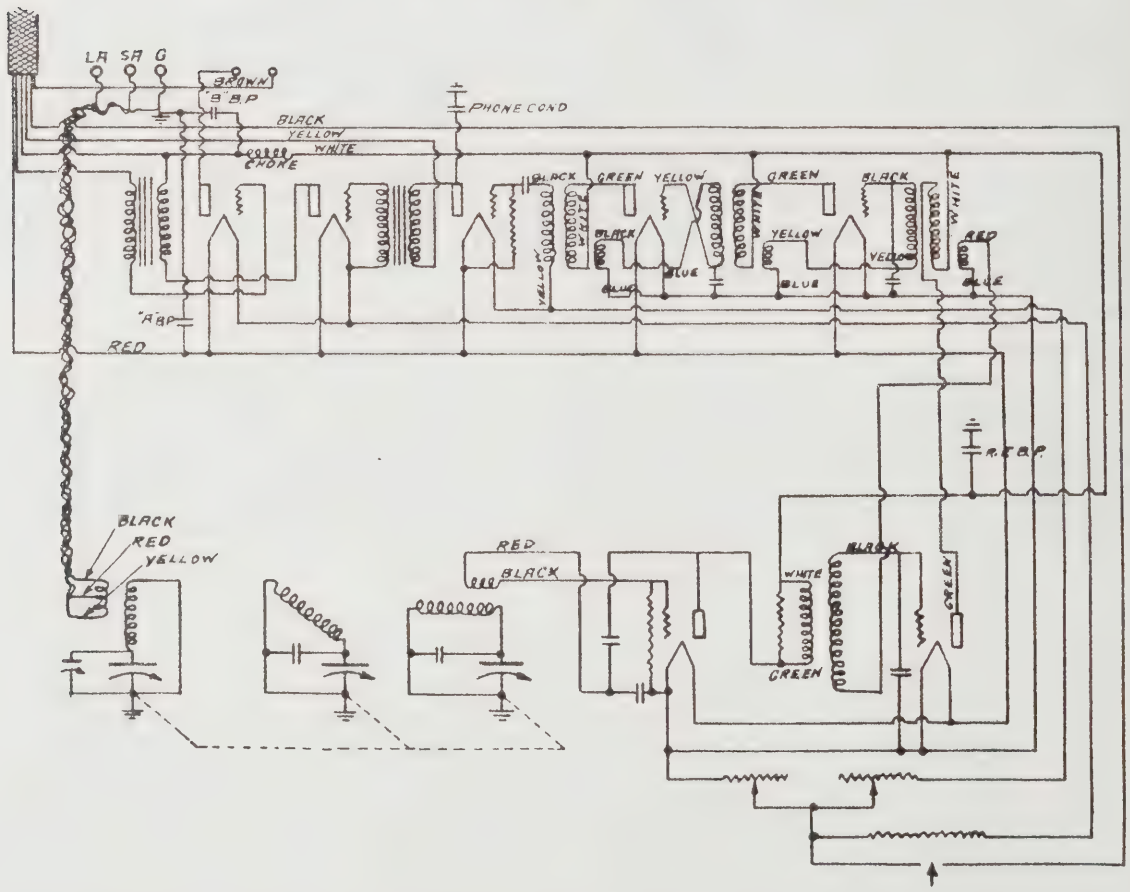


FIG. 50. WIRING DIAGRAM OF MODEL 50.

NOTE.—Black lead (—F) is grounded—not shown in diagram. Most of Model 50 Sets also have an R.F. choke between plate of second audio tube and speaker post No. 1.

Continuity Test Table—Model 50

(Colors Refer to Cable Leads, Unless Otherwise Specified)

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
(For following tests place Filament Switch "on" and Rheostats barely "on.")			Examine cable for open leads, broken connections and short circuits. Repair or replace cable if necessary.
BLACK to			
—F of each R.F. socket.	*Full*	Open in cable, wiring or R.F. rheostat.	R.F. rheostat at left.
—FD	*Full*	Open connection or open det. rheostat.	Detector rheostat at right.
—F of each A.F. socket.	*Full*	Open con. or open A.F. fil. fixed resis.	
Ground Post.	*Full*	Open ground connection.	
Each Antenna Post	*Full*	Open antenna coil or connection.	
Stator of each Variable Condenser.	*Full*	Open sec. ant. trans., or open tuned coupling coil, or open primary 3rd tuned circuit.	Located in container at rear of variable condensers.
Plate of each R.F. socket.	*None*	Nos. 1, 2, 3, 4 R.F.T. pri. circuit grounded.	Or shorted "B" or R.F by-pass condenser, or shorted balancing condenser.
PD	*None*	No. 1 A.F.T. primary circuit grounded.	Or shorted phone condenser.
Red	*None*	Grounded positive filament circuit or shorted "A" by-pass condenser.	
P1A	*None*	No. 2 A.F.T. primary circuit grounded.	
G2R	*Nearly Full*	None—Open secondary No. 1 R.F.T. or open auxiliary coil No. 2 R.F.T.	Full—Shorted secondary or shorted fixed secondary condenser.
G3R	*Nearly Full*	None—Open secondary No. 2 R.F.T. or open auxiliary coil No. 3 R.F.T.	Full—Shorted secondary or shorted fixed secondary condenser.
G4R	*Nearly Full*	None—Open secondary No. 3 R.F.T. or open auxiliary coil No. 4 R.F.T.	Full—Shorted secondary or shorted fixed secondary condenser.
GD	*None*	Shorted detector grid condenser.	
Black sec. lead of No. 4. R.F.T.	*Nearly Full*	Open secondary No. 4 R.F.T.	Full—Shorted secondary.
G1A	*Partial*	None—Open secondary No. 1 A.F.T.	Full—Shorted sec. No. 1 A.F.T.
G2A	*None*	Grounded secondary circuit No. 2 A.F.T.	
RED to			
+F of all sockets.	*Full*	Open cable lead or connection.	
WHITE to			
Plate of each R.F. socket.	*Nearly Full*	None—Open cable lead or primary No. 1, 2, 3, or 4 R.F.T., or open R.F. choke coil.	
P1A	*Partial*	None—Open primary No. 2 A.F.T.	Full—Shorted primary.
YELLOW to			
PD	*Partial*	None—Open pri. No. 1 A.F.T.	Full—Shorted primary.
BROWN to			
Speaker Post No. 2	*Full*	Open cable lead or connection.	
OTHER TESTS			
P2A to Speaker Post No. 1	*Nearly Full*	Open connection or open output R.F. choke.	
Green-Yellow Tracer to G2A	*Partial*	None—Open cable lead or sec. No. 2 A.F.T.	Full—Shorted secondary.
G1R to Center Screw of Balancing Condenser.	*Nearly Full*	None—Open secondary 3rd tuned circuit.	
Center Screw of Balancing Condenser to —F1R.	*None*	Shorted grid section of balancing condenser.	

Model 36 Set

General Description

Model 36 is a six-tube, single-dial receiver designed for A. C. tubes, with filament, plate and grid voltages supplied by type "Y" Atwater Kent power unit.

Model 36 has three stages of tuned radio frequency amplification, a tuned detector circuit and two stages of audio frequency amplification, the second audio stage being designed for a power tube. The R. F. transformers are of the double-coil type. The first variable condenser has an independently variable plate which is adjustable to compensate for the effects of different antenna sizes.

Connections from the set to power unit are made by means of a heavy cable terminating in a cable connection panel which fits over the corresponding terminals on the power unit. The power unit is provided with a cord and plug for insertion in the A. C. lighting socket. The power unit is designed for use on standard house supply of electricity, 110 volts, 60 cycle alternating current.

The volume of reception in the Model 36 is controlled by means of a double resistance coil, so connected as to by-pass equally from the plates of the first two R. F. tubes, any desired amount of energy, thereby giving a smooth and accurate control of volume. In a few of the earlier sets, the volume was controlled by varying a series capacity in the plate circuit of the first R. F. tube, by means of a tap-switch controlling a group of fixed condensers connected in series.

The correct grid bias voltage is supplied to the various tubes by grounding all the grid returns and then connecting the ground to the filament circuit of the various tubes, through resistances of the correct value in each case. Since the negative of the "B" voltage output of the rectifier is grounded, and the filament voltage relatively positive, the resulting "C" voltage secured on the grid from the ground will be negative. It should be noted(see schematic diagram) that since an A. C. voltage is being applied to each side of the filament of the tube, it is necessary in order to get a constant voltage value from the filament to obtain a connection from the center of the filament. This is done by taking a tap-off at the mid-point of a resistance shunted across the filament terminals. The lead from this tap is connected through a resistance of the correct value in each case to the minus B or ground, to which all grid returns are connected.

A protective choke and condenser are used to keep the high-voltage direct current supplied to the plate of the last audio tube, from passing through the magnet windings of the speaker. This also improves the quality of reception.

The "B" power supply incorporated in the "Y" power unit is very much the same as the regular Model "R" "B" power unit, except that a standard filament type rectifier tube is used. The filament of this tube performs the same function as the grid electrode in the A. K. rectifier tube, a connection leading out from the filament, through the required chokes, to the positive "B" voltage supply terminal. (See Section VII.)

The starting and stopping of the set is accomplished by a toggle switch connected in series with the primary of the A. C. transformer, which is the same as being in series with the 110 volt A. C. house line.

Information about A. C. sets in general and power units is given in Section I.

Diagrams and test tables for Model 36 are given on pages 46 and 47. The "Y" type power unit is described on pages 48, 49, 50 and 51.

Removing Set from Cabinet and Panel

Place set on table with panel facing up, remove wood screws from around edges of panel and then lift set out vertically, inserting the finger nails under edge of panel. Do not lift by dial or other parts. See that cable can pass freely through hole in back of cabinet as set is being lifted out. It will be necessary to slide the chassis slightly to the left before it can be lifted out, to allow the by-pass condenser to clear.

The chassis is attached to the panel by seven screws, three in a row at each end and one near the centre of the vertical side of the metal frame. Remove these screws, remove the dial, the vernier knob and the antenna adjustment knob (at left end). The panel may then be lifted clear of the chassis. If it is desired to separate the panel from the chassis, unsolder the two cable connections to toggle switch, and also, in the case of old style condenser-type volume controls, unsolder the leads from volume control.

Replacing Variable Condensers

If one variable condenser is defective, replace entire group of four condensers. Part No. 9190. Use pulleys and belts of original group.

Procedure: Remove chassis from panel. Loosen twelve screws holding variable condensers to metal frame. Note how pulleys and belts are arranged and then remove them. Replace one condenser at a time. Do not mix the old condensers with the replacements.

Remove the double R. F. transformers which are mounted on backs of variable condensers (do not unsolder transformer leads), at the same time removing the grid resistors, the grid condenser and the lugs of secondary leads which are held to the condensers by the same nuts that hold the R. F. transformer brackets.

Remove the three screws holding first condenser, lift out the condenser and put in replacement without tightening screws. Mount the first R. F. transformer, the first grid resistor and the secondary lead lug, on the two bolts on back of the condenser. Make certain that the axes or long sides of the transformer coils are vertical. This may be checked by seeing that the sides of coils are parallel to the vertical metal strip on the back of the condenser.

Repeat procedure with each condenser and, when all four are in place, put on the pulleys and belts, adjust belt tension and synchronize condensers. (See Section XI.)

Replacing R. F. Transformers

If one double R. F. transformer is defective, replace entire group of four transformers. Part No. 9590.

The antenna transformer may be identified by its white lead.

No. 1 R. F. T. has one green lead.
No. 2 R. F. T. has one yellow lead.
No. 3 R. F. T. has one blue lead.

In replacing double R. F. transformers, substitute one transformer at a time, mounting and connecting the replacement exactly like the original. Do not mix up the old coils with the replacements.

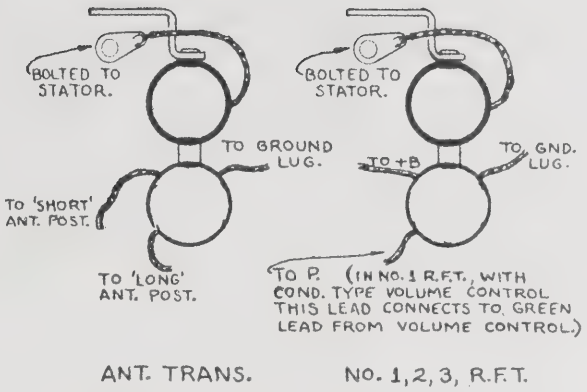


Fig. 51. Sketch Showing Connections From Antenna Transformer and From R. F. Transformers.

Remove two nuts on back of the first variable condenser which hold R. F. transformer brackets, unsolder transformer connections and remove old transformer. Put replacement transformer in position, seeing that the grid resistor and lug of secondary lead are replaced properly, and tighten the two nuts. The transformer angle brackets must be arranged so that the axis or long sides of the coil are vertical. This may be checked by seeing that the long sides of the coils are parallel to the vertical metal strip across the back of the variable condenser. Solder leads exactly like the original. Repeat procedure with each R. F. transformer.

Diagrams and Test Table for Model 36 are given on Pages 46 and 47.

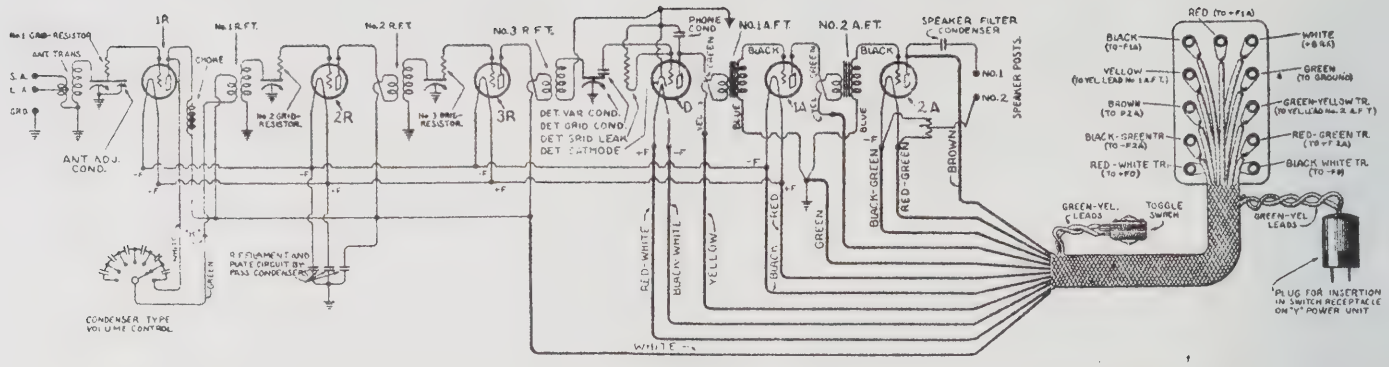


FIG. 52. WIRING DIAGRAM OF MODEL 36 WITH CONDENSER TYPE VOLUME CONTROL AND CABLE CONNECTION PANEL FOR EARLY MODEL "Y" POWER UNIT. (Note that the +B 1st A.F. cable lead is green with a yellow tracer. In some Model 36 sets, and in all other Atwater Kent A.C. receivers, a black-red tracer is used for this connection.)

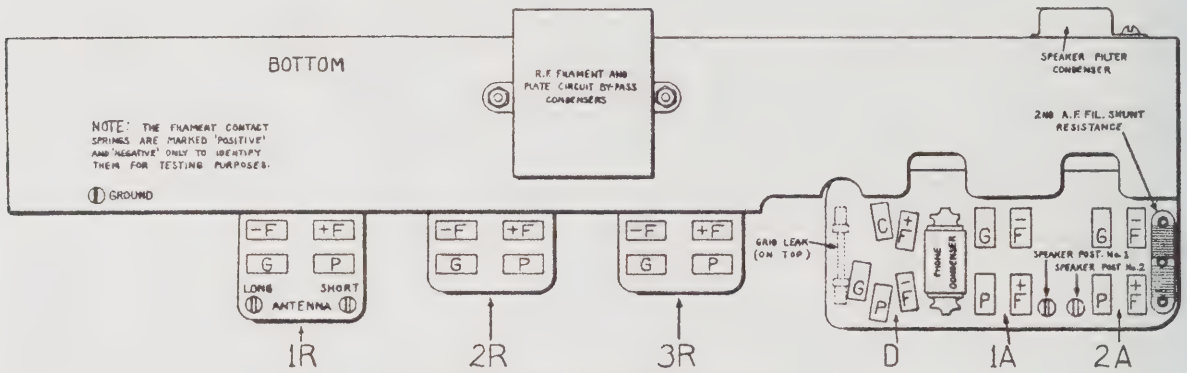


FIG. 53. TEST CHART FOR MODEL 36.

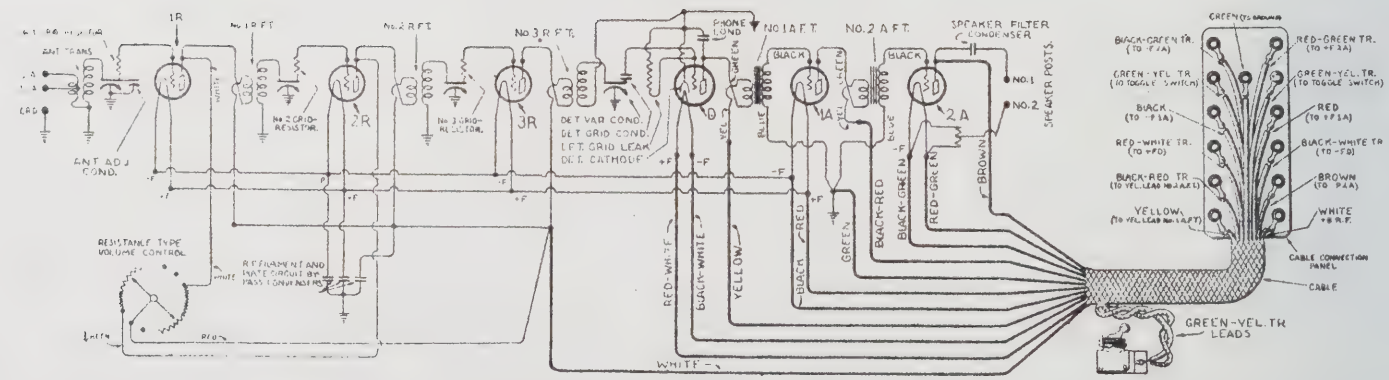


FIG. 54. WIRING DIAGRAM OF MODEL 36 WITH RESISTANCE TYPE VOLUME CONTROL AND CABLE CONNECTION PANEL FOR LATER MODEL "Y" POWER UNIT. (Note that the red and the black cable leads feed the R.F. filaments as well as the 1st A.F. filament. In some Model 36 sets the +B 1st A.F. cable lead is green with a yellow tracer.)

Continuity Test Table—Model 36

(Colors Refer to Cable Leads)

For Following Tests Remove Cable Panel from Power Unit

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
Red-Green Tr. to +F2A Black-Green Tracer to —F2A Red-White Tr. to +FD Black-White Tracer to —FD Red to +F1A Black to —F1A Green to Ground Post. Brown to P2A	*Full*	Open in cable or connection.	Examine soldered connections at cable connection panel and set.
GREEN to			
P1A	*None*	Grounded 1st A.F. plate circuit.	
PD	*None*	Grounded detector plate circuit.	Or shorted phone condenser.
P3R	*None*	Grounded R.F. plate circuit.	Or shorted R. F. by-pass condenser.
+F3R, —F3R	*None*	Grounded R.F. 1st A.F. filament circuit.	Or shorted R. F. by-pass condenser.
+FD, —FD	*None*	Grounded detector filament circuit.	
+F2A, —F2A	*None*	Grounded 2nd A.F. filament circuit.	
G1R, G2R, G3R	*Partial*	None—Open grid res. or open sec. of ant transformer or No. 1 or 2 R.F.T.	Full—Shorted grid resistor. Test resistors separately. (Mounted on back of R.F. variable condensers.)
G1A	*Partial*	None—Open secondary No. 1 A.F.T.	Full—Shorted grid circuit.
G2A	*Partial*	None—Open secondary No. 2 A.F.T.	Full—Shorted grid circuit.
Stator of Detector Variable Condenser.	*Full*	Open secondary last R.F.T.	
CD	*Full*	Open cathode lead.	
WHITE to			
P1R, P2R, P3R (Volume Control Turned Full Right.)	*Full*	Open primary No. 1, 2, 3 R.F.T.	Or open plate circuit choke in cond.-choke type volume control.
YELLOW to			
PD	*Partial*	None—Open primary No. 1 A.F.T.	Full—Shorted primary.
+B 1st A.F. Lead (Black-Red, or Green-Yellow) to P1A	*Partial*	None—Open primary No. 2 A.F.T.	Full—Shorted primary.
OTHER TESTS			
GD to Stator Last Variable Condenser.	*None*	Shorted grid condenser.	Mounted on back of detector variable condenser.
P2A to Speaker Post No. 1.	*None*	Shorted speaker filter condenser.	
Green to each Ant. Post.	*Full*	Open primary antenna transformer.	
Speaker Post No. 2 to —F2A, +F2A	*Full*	Open connection or open 2nd A.F. filament shunt resistance.	
Across Switch Plug Contacts. (Before Serial No. 2,610,000.) (Toggle Switch "On.")	*Full*	Open in switch leads or connection.	No reading with toggle switch "off."
Across Green-Yellow Tracer Leads on Cable Connection Panel. (After Serial No. 2,610,000.) (Toggle Switch "On.")	*Full*	Open in switch leads or connections.	No reading with toggle switch "off."
Res. Type Vol. Control. P1R to P2R (Turn Knob.)	*Nearly Full*	Defective resistance winding or slider.	No reading with knob turned full right.
Condenser-Choke Type Volume Control. White to Point K (on Primary No. 1 R.F.T.)	*Full*	Open primary No. 1 R.F.T.	
P1R to Point K (Unsolder One Choke Lead.)	*None*	Shorted condenser in volume control.	Test with volume control switch on each tap. Resolder lead.

Model "Y" Power Units below Serial No. 260,000

(Used with Model 36 Sets below Serial No. 2,610,000)

General Description

Model "Y," below Serial No. 260,000, is a complete power unit enclosed in a metal case separate from the receiving set. It is designed to operate from 110 volt, 60 cycle, alternating current and furnish complete filament, plate, and grid voltages to Model 36 sets bearing serial numbers below 2,610,000. (Model 36 receiving sets above Serial No. 2,610,000 used a later type of "Y" power unit which is described on the next pages.)

Information about Atwater Kent power units is given in the first section of this manual.

In Model "Y" power units below Serial No. 260,000, a potentiometer is connected across the R. F. first A. F. filament circuit. It is to be adjusted with the slider at approximately the center point for least hum in reception.

A receptacle in series with one side of the 110 volt A. C. line is mounted on the front of the unit case. A toggle switch on the panel of the set is connected to this receptacle through two green-yellow tracer leads in the set cable. The leads are connected to a plug for insertion in the receptacle. The toggle switch on the set turns the 110 volt A. C. supply on or off.

A regulating or "load" resistance in the unit is connected across the B+ and B— output terminals. This resistance is wound on a form on which two grid bias resistances are also wound.

The unit has four separate metal containers, one for the power transformer, one for the filter chokes, a third for the fixed condensers and a fourth for the speaker (output) choke and for a by-pass condenser that is connected to the first A. F. plate circuit resistance.

Removing Power Unit from Case

Remove the four screws around cover, the four felt-headed feet and the single round-head machine screw at the bottom of the case. Remove the three screws holding potentiometer and the four screws at corners of the panel assembly. Unsolder connections to switch receptacle and unsolder the connection between one line of 110 volt cable and one lead from the primary of the power transformer. Unscrew the hexagon nut from back of receptacle and remove receptacle. Pull the 110 volt cable up and take out the knot. Pull cable out of

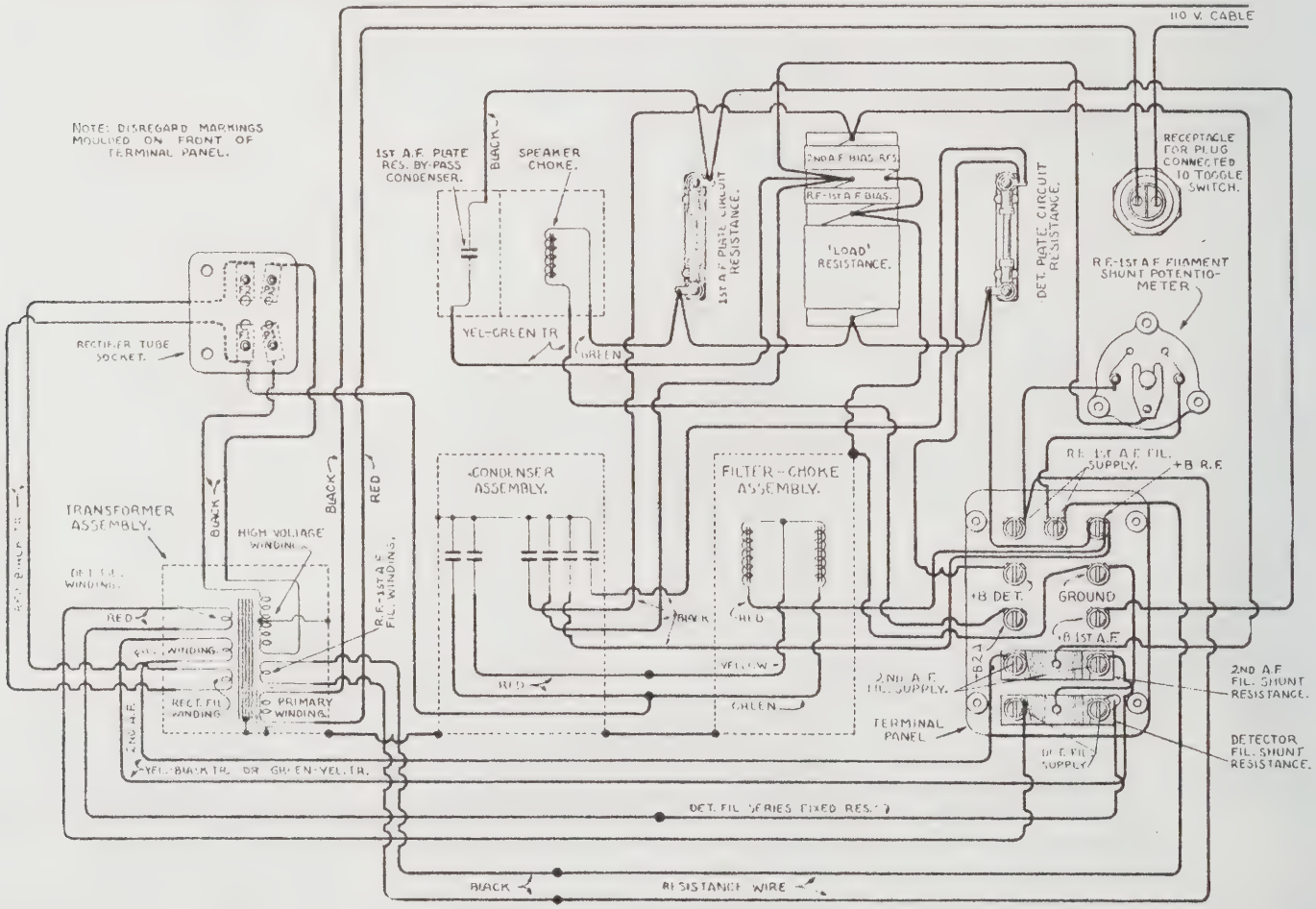


FIG. 55. WIRING DIAGRAM OF "Y" POWER UNIT BELOW SERIAL NO. 260,000. (The two leads to any one secondary winding may be reversed without affecting results.) This diagram shows the **APPROXIMATE** relative position of leads from the sealed containers.

case and remove soft rubber bushing through which cable enters unit. Push the potentiometer and panel assembly back so the unit may be withdrawn from the case. Leads from the different sections come out on one side; rest the case on opposite side and carefully draw out the unit.

A brief inspection will show that loosening the nuts on the three long bolts releases the various sections. Note how the flexible metal strips from each section are soldered together, and that the flexible metal strip at the top of the condenser section is laid under the heavy metal strip which clamps the choke and the condenser sections to the base.

Testing

Apply the continuity tests given in the table on this page. If the tests indicate that one section of the unit is defective, replace that section, connecting it exactly as the original.

When replacing the unit in its case make certain that all soldered joints on loose wires are insulated with tubing or with electrician's tape.

Continuity Test Table—"Y" Power Unit (Early Type)

TEST	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
Across 2nd A.F. Filament Supply.	*Full*	None—Open 2nd A.F. fil. winding and open 2nd A.F. filament shunt resistance.	Nearly Full—Open filament winding. (Unsolder one filament winding connection and test winding and filament shunt resistance separately.)
Across R.F.-1st A.F. Filament Supply.	*Full*	None—Open R.F.-1st A.F. fil. winding and open filament shunt potentiometer.	Nearly Full—Open filament winding. (Unsolder one filament winding connection and test winding and filament shunt resistance separately.)
Across Detector Filament Supply.	*Full*	None—Open det. fil. winding and open detector filament shunt resistance.	Nearly Full—Open filament winding. (Unsolder one filament winding connection and test winding and filament shunt resistance separately.)
From Ground to each Metal Container.	*Full*	Open ground connection.	
FROM +B R.F. to			
+B 2nd A.F.	*Partial*	None—Open speaker (output) choke.	Full—Shorted choke.
+B 1st A.F.	*Small*	None—Open 1st A.F. plate circuit resis.	
+B Detector.	*Very Small*	None—Open detector plate circuit resistance.	
Ground.	*Partial*	None—Open regulating resistance.	Full—Shorted regulating resistance, or shorted filter condenser.
F1 (on Rectifier Tube Socket.)	*Partial*	None—Open plate supply filter choke.	
FROM GROUND to			
+B 1st A.F.	*Small*	Full—Shorted by-pass condenser.	**(NOTE: If any of the condensers is thought to be defective, unsolder leads from the rest of the circuit and test each condenser separately. The plate supply filter chokes may be tested in the same manner.)**
+B Detector.	*Very Small*	Full—Shorted by-pass condenser.	
One Side of 2nd A.F. Filament Supply.	*Partial*	None—Open 2nd A.F. grid bias resistance.	Full—Shorted grid bias resistance or shorted by-pass condenser.
One Side of R.F.-1st A.F. Filament Supply.	*Partial*	None—Open R.F.-1st A.F. grid bias resis.	Full—Shorted grid bias resistance or shorted by-pass condenser.
One Side of Dector Filament Supply	*Full*	None—Open connection to center-tap of detector filament shunt resistance.	Examine connections under panel assembly.
P1, P2 (on Rectifier Tube Socket.)	*Nearly Full*	None—Open high voltage secondary winding or connections.	
Both Terminals of A.C. Plug.	*None*	Grounded primary of power transformer.	Inspect cable and primary leads for accidental grounds.
OTHER TESTS			
Across Terminals of A.C. Plug. (Short Circuit the Terminals of the Switch Receptacle.)	*Full*	Open primary circuit of power transformer.	
F1 to F2 (on Rectifier Tube Socket.)	*Full*	Open rectifier fil. winding or connection	

Model "Y" Power Units Above Serial No. 260,000

(Used with Model 36 Sets above Serial No. 2,610,000)

General Description

Model "Y," above Serial No. 260,000, is a complete power unit enclosed in a metal case separate from the receiving set. It is designed to operate from 110 volt alternating current and to furnish complete filament, plate, and grid voltages to Model 36 receivers bearing serial numbers above 2,610,000. (Model 36 sets below Serial No. 2,610,000 use the earlier type "Y" power unit which is described on the preceding pages.)

The panel assembly of the later type unit is mounted inside the metal case of the unit. This assembly contains terminals for connection to the set "cable connection panel," three center-tapped filament shunt resistances, two grid bias resistances, a resistance in series with the detector plate circuit and a resistance in series with the first A. F. plate circuit. Two of the terminals connect, through the set cable, to a toggle switch mounted on the panel of the set. This toggle switch turns the 110 volt A. C. supply on or off.

The unit has three metal containers, one for the power transformer, one for the filter and speaker choke, and one for the fixed condensers.

Removing Unit From Case

Remove the four felt-headed feet and the single round-head machine screw at the bottom of the cabinet. Leads from the various sections come out on one side; rest cabinet on opposite side and carefully draw out the unit. The various sections are held to the base by three long bolts and two heavy metal strips. The panel assembly is mounted on one of the metal strips by two bolts and nuts—one the ground terminal and the other at the center toward the opposite end of the panel assembly. Note how the flexible metal strips from the containers are soldered together and that the strip at the top of the condenser section is laid under the heavy metal strip which holds down the condenser and choke coil sections.

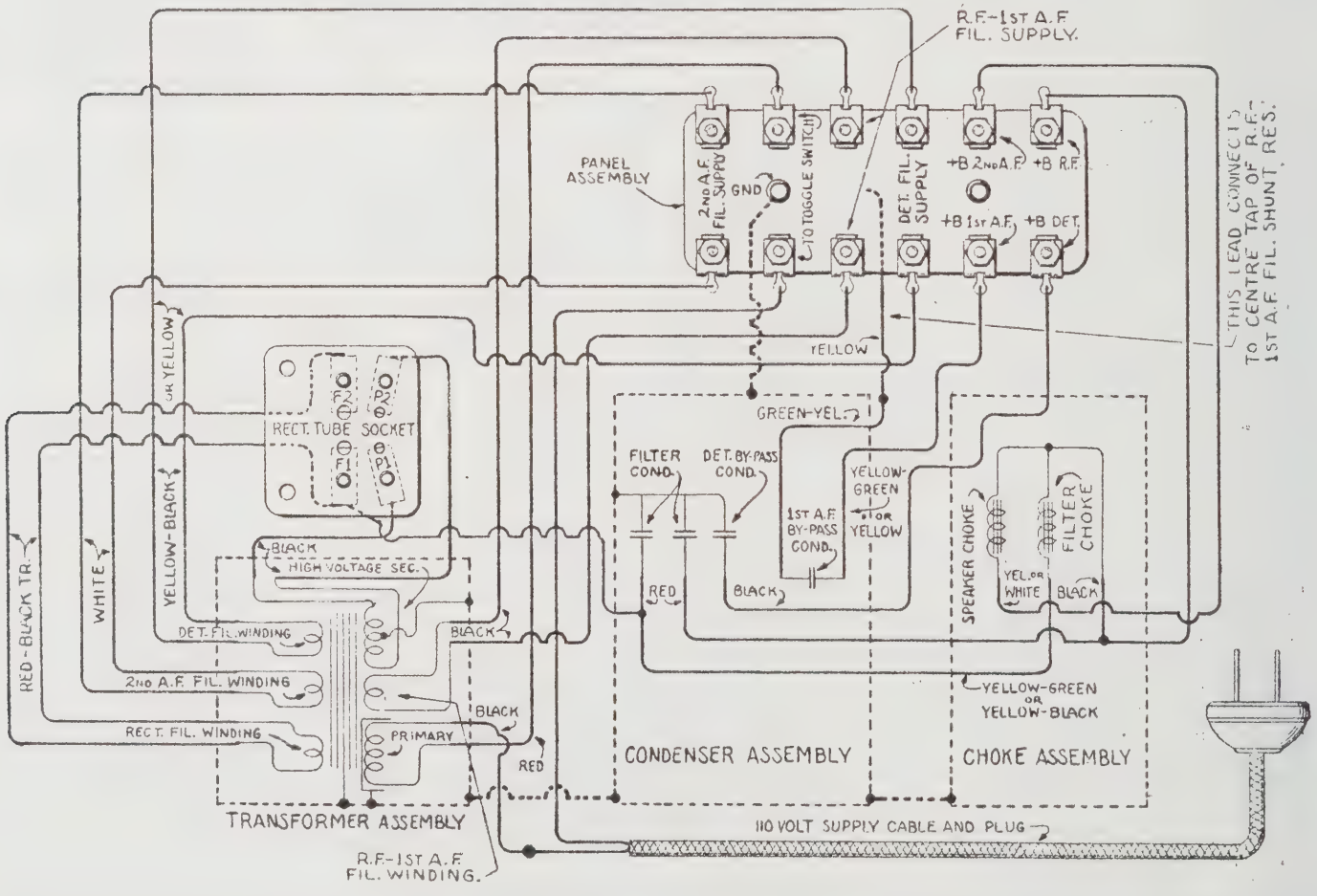


FIG. 56. WIRING DIAGRAM OF "Y" POWER UNIT ABOVE SERIAL NO. 260,000. (The connection to the ground terminal is made indirectly through a flexible metal strip. A rear view of the panel assembly is shown in the description of the power unit for Model 37 and 38 receivers. The above diagram shows the **APPROXIMATE** relative position of leads from the sealed containers.)

Testing

Apply the continuity tests given in the table on this page. If the tests indicate that one of the sections is defective, that section should be replaced, mounting and connecting the replacement exactly as the original.

When replacing the unit in its case, make certain that all soldered joints on loose wires are insulated with tubing or with electrician's tape.

Continuity Test Table—"Y" Power Unit (Later Type)

TEST	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
From Ground to Each Metal Container.	*Full*	Open ground connection.	
Across 2nd A.F. Filament Supply.	*Full*	None—Open 2nd A.F. fil. winding and open 2nd A.F. filament shunt resistance.	Nearly Full—Open filament winding. (Unsolder one filament winding connection and test winding and filament shunt resistance separately.)
Across R.F.-1st A.F. Filament Supply.	*Full*	None—Open R.F.-1st A.F. filament winding. and open filament shunt resistance.	Nearly Full—Open filament winding. (Unsolder one filament winding connection and test winding and filament shunt resistance separately.)
Across Detector Filament Supply.	*Full*	None—Open detector filament winding and open detector filament shunt resistance.	Nearly Full—Open filament winding. (Unsolder one filament winding connection and test winding and filament shunt resistance separately.)
FROM +B R.F. to			
+B 2nd A.F.	*Partial*	None—Open speaker output choke.	Full—Shorted speaker choke.
+B 1st A.F.	*Small*	None—Open 1st A.F. plate circuit resistance.	
+B Detector.	*Very Small*	None—Open detector plate circuit resistance.	
Ground.	*None*	Shorted filter condenser.	
F1 (on Rectifier Socket).	*Partial*	None—Open plate supply filter choke.	
FROM GROUND to			
+B 1st A.F.	*None*	Shorted by-pass condenser.	(NOTE: If either of the by-pass condensers is thought to be defective, unsolder its lead from the rest of the circuit and test the condenser separately.)
+B Detector.	*None*	Shorted by-pass condenser.	
One Side of 2nd A.F. Filament Supply.	*Partial*	None—Open 2nd A.F. grid bias resistance.	Full—Shorted grid bias resistance.
One Side of R.F.-1st A.F. Filament Supply.	*Partial*	None—Open R.F.-1st A.F. grid bias resis.	Full—Shorted grid bias resistance.
One Side of Detector Filament Supply.	*Full*	Open connection to center-tap of detector filament shunt resistance.	Examine connections under panel assembly.
P1, P2 (on Rectifier Tube Socket.)	*Nearly Full*	None—Open high voltage secondary winding or connections.	
Each Terminal of A.C. Plug.	*None*	Grounded primary of power transformer.	Examine primary connections for accidental grounds.
OTHER TESTS			
Across Terminals of A.C. Plug. (Short Circuit Toggle Switch Terminals on Panel Assembly.)	*Full*	Open primary power transformer or open leads.	
F1 to F2 (on Rectifier Tube Socket).	*Full*	Open rectifier fil. winding or connections.	

General Description

Model 37 is a six-tube, single-dial, A. C. type radio receiver with a complete power unit incorporated in the metal cabinet that houses the set. The power unit operates from 110 volt, 60 cycle, alternating current (special model for 25 cycle current) and supplies complete filament, plate and grid voltages to the set.

Model 37 has three stages of radio frequency amplification, the first stage acting as an untuned coupling tube, in order to eliminate the detuning effect of different antenna sizes, which would otherwise disturb synchronism of the three tuned circuits.

The volume control in the Model 37 consists of a variable resistance connected directly between the antenna and ground posts of the set. When the knob of this control is full "on" the slider passes off the coil, cutting the latter out of the circuit entirely. As the control is turned back, less and less resistance is included between the aerial and ground, so that more and more of the energy of the incoming signal is shunted to the ground instead of passing into the set—thereby the volume is reduced as desired.

Removing Chassis from Cabinet

First remove cover from power unit by taking out the two screws at its lower outside ends, and four screws at bottom of front. Lift cover off vertically, exposing set cable connection panel. Remove nuts from bolts which pass through holes in cable connection panel and lift connection panel off, releasing cable from power unit.

Take out the six screws, three in a row at each end, which clamp the metal frame of chassis to brackets at inside front of cabinet. Remove vernier knob and

(Continued on page 54.)

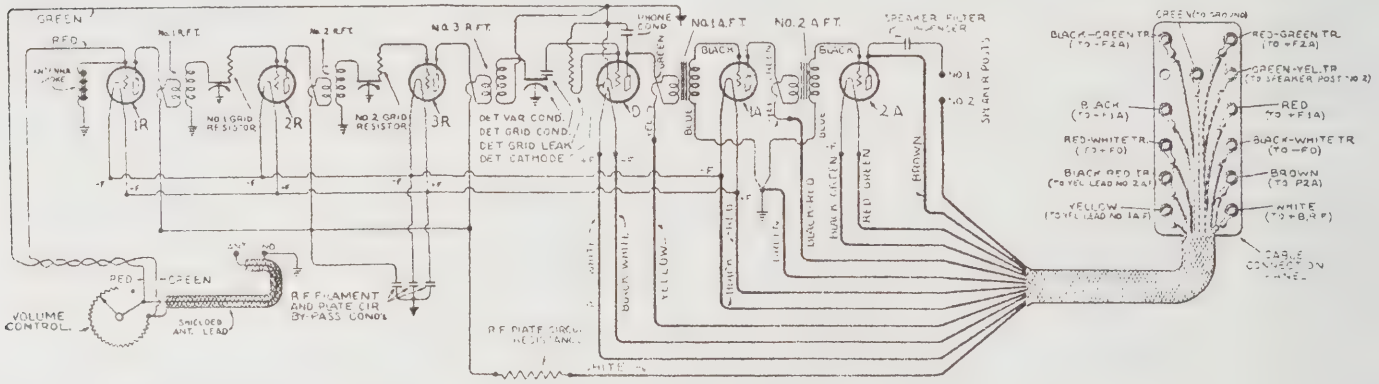


FIG. 57. WIRING DIAGRAM OF MODEL 37. (A 2nd A.F. filament shunt resistance is used before Serial No. 1,385,000, in which case speaker post No. 2 connects to the centre-tap of this resistance, and the green-yellow tracer lead is not used. The R.F. plate circuit resistance is used after Serial No. 1,385,000. Note that the red and the black cable leads feed the R.F. filaments as well as the 1st A.F. filament.)

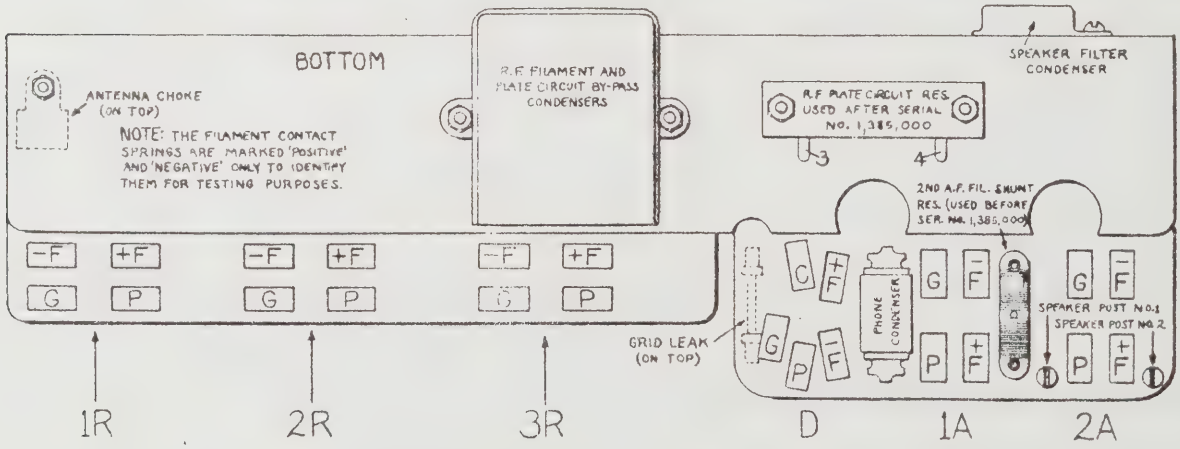


FIG. 58. WIRING CHART FOR MODEL 37.

Continuity Test Table—Model 37

Colors Refer to Cable Leads

For Following Tests Remove Cable Panel from Power Unit

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
Red-Green Tr. to +F2A Black-Green Tracer to —F2A Red-White Tr. to +FD Black-White Tracer to —FD Red to +F1A Black to —F1A Green-Yellow Tracer to Speaker Post No. 2. (After Serial No. 1,385,000.) Green to Ground Post. Brown to P2A. White to 4 (on R.F. Plate Resistance. (After Serial No. 1,385,000.)	*Full*	Open in cable or connection.	Examine soldered connections at cable connection panel and set.
GREEN to			
P1A	*None*	Grounded 1st A.F. plate circuit.	
PD	*None*	Grounded detector plate circuit.	Or shorted phone condenser.
P3R	*None*	Grounded R.F. plate circuit.	Or shorted R.F. by-pass condenser.
+F3R, —F3R	*None*	Grounded R.F. 1st A.F. filament circuit.	Or shorted R.F. by-pass condenser.
+FD, —FD	*None*	Grounded detector filament circuit.	
+F2A, —F2A	*None*	Grounded 2nd A.F. filament circuit.	
G2R, G3R	*Partial*	None—Open grid resistor or secondary No. 1, 2 R.F.T. Full—Shorted grid circuit.	Test across resistors and secondaries separately. (Resistors mounted on back of R.F. var. conds.)
G1R (Volume Control Full Right.)	*Full*	Open antenna choke.	
G1A	*Partial*	None—Open secondary No. 1 A.F.T.	Full—Shorted secondary.
G2A	*Partial*	None—Open secondary No. 2 A.F.T.	Full—Shorted secondary.
Stator of Detector Variable Condenser	*Full*	Open secondary last R.F.T.	
CD	*Full*	Open cathode lead.	
WHITE to			
3 (on R.F. Plate Res.) (After Serial No. 1,385,000.)	*Partial*	None—Open R.F. plate circuit resistance.	Full—Shorted R.F. plate circuit res.
P1R, P2R, P3R.	*Partial**	Open primary No. 1, 2, 3 R.F.T.	
YELLOW to PD	*Partial*	None—Open primary No. 1 A.F.T. (or open in cable connection).	Full—Shorted primary.
Black-Red, Tr. to P1A	*Partial*	None—Open primary No. 2 A.F.T. (or open in cable connection).	Full—Shorted primary.
OTHER TESTS			
GD to Stator of Last Condenser.	*None*	Shorted grid condenser.	Mounted on back of det. var. cond.
P2A to Speaker Post No. 1.	*None*	Shorted speaker filter condenser.	
G1R to Antenna Post.	*Full*	Open antenna connection.	
Speaker Post No. 2 to —F2A, +F2A (Before Serial No. 1,385,000.)	*Full*	Open connection or open 2nd A.F. Filament shunt resistance.	
To Test Volume Control, Unsolder Lead from Antenna Choke to G1R and Test Across Antenna and Ground Posts, Turning Control Knob.	*Smooth and Nearly Full*	No reading—open resistance winding. Erratic reading—damaged resistance winding or slider.	If found defective, repair or install new control. Resolder antenna choke lead.

* The reading from **WHITE** to the plate of each R.F. tube is "full" in Model 37 sets prior to Serial No. 1,385,000.

tuning dial. Remove two screws which hold antenna-and-ground post bracket on inside back of cabinet. This bracket is not used on some Model 37 sets. Pull sub-panel straight back horizontally to allow volume control knob and dial shaft to clear, then lift set up and out.

Replacing Variable Condensers

If one variable condenser is defective, replace entire group of three variable condensers.

No. 9100 for Model 37 sets previous to Serial No. 1,360,000.

No. 13170 for Model 37 sets after Serial No. 1,360,000.

Use pulleys and belts of original group.

Procedure: Loosen nine screws holding condensers to front of metal frame. Note how pulleys and belts are arranged and then remove them. Replace one condenser at a time.

Remove two nuts on back of first variable condenser, which clamp grid resistor (grid condenser on last variable condenser) and lug of secondary lead. Remove three screws holding condenser to chassis and lift out the condenser.

Put in the replacement condenser and its three screws, without tightening screws, attach grid resistor and lug of secondary lead to top and bottom bolts respectively on back of condenser. Repeat procedure with other two variable condensers. When the replacement condensers are installed, put on the pulleys and belts, adjust belt tension and synchronize condensers. (See Section XI.)

Replacing R. F. Transformers

If one R. F. transformer is defective, replace R. F. amplifier assembly.

No. 9660 for sets below Serial No. 1,265,000.

No. 13030 for sets between Serial Nos. 1,265,000 and 1,385,000.

No. 13160 for sets above Serial No. 1,385,000.

Procedure: The R. F. amplifier assembly consists of three R. F. transformers mounted on a three-socket moulded base. The filament contacts are wired and have two leads for connection to filament contacts of first A. F. socket. The plate circuits are wired and have one lead for connection to the +B, R. F. (white) cable lead (in Model 37 sets up to Serial No. 1,385,000) or to the left-hand contact (No. 3) on the R. F. plate circuit resistance in Model 37 sets after Serial No. 1,385,000. A lead from the grid-end of each R. F. transformer is soldered to a lug which is to be fastened to the bottom bolt on back of the variable condenser immediately in front of each R. F. transformer. The three return leads from secondaries of R. F. transformers are to be soldered to (ground) lugs which are held by bolts that clamp the R. F. amplifier base to the frame of set.

In replacing R. F. amplifier assembly, the chassis must be removed from the cabinet or front panel. Unsolder three leads from by-pass condenser, leads from grid contact of the first R. F. socket, leads from the grid resistor (unsolder at grid contacts of sockets) two filament circuit leads (at filament contacts of first A. F. socket), and the +B, R. F. lead. Remove secondary wire lug from bottom bolt on each variable condenser. Unsolder, at grid contact, the lead from grid condenser, which lead passes through a hole in the R. F. base. Unsolder three leads from secondaries of R. F. transformer where they are soldered to lugs under bolts holding R. F. base to metal frame. Remove five bolts holding R. F. base to metal chassis and remove the old R. F. amplifier assembly.

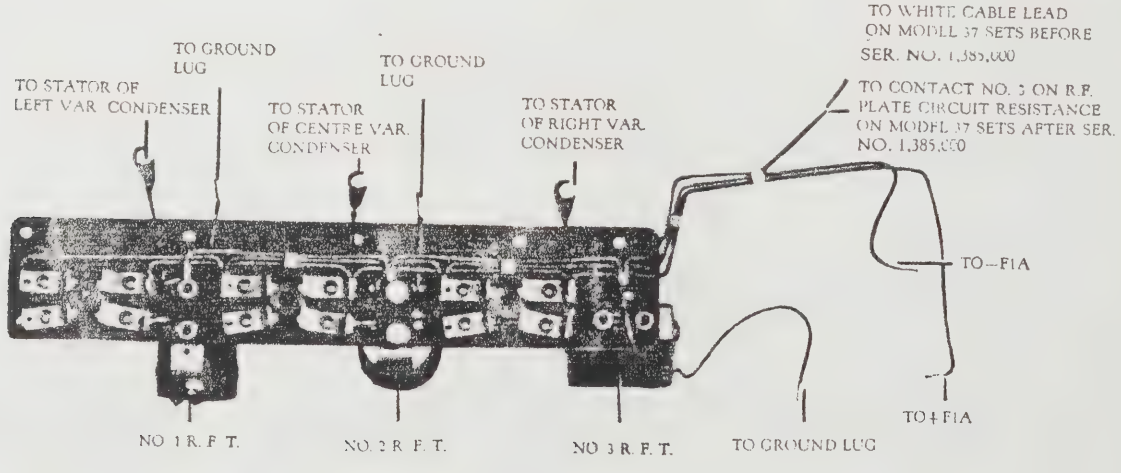


Fig. 59. View of R.F. Amplifier, Showing Where Each Wire Is To Be Connected.

Reassemble with replacement R. F. amplifier, reversing above procedure.

Replacing Volume Control

No. 9510 for Model 37 sets below Serial No. 1,265,000.

No. 13020 for Model 37 sets above Serial No. 1,265,000.

In replacing the volume control, the chassis must be removed from the cabinet.

The control is held to the front of the vertical side of the chassis by two screws and nuts, and it is mounted in such a way that the terminals of the control are at the right-hand side when looking at the chassis in its normal position. Remove the two screws, using a long-nose pliers to grip the nut on the bottom screw, which is somewhat hidden by the first audio transformer.

A red lead is soldered to the center (slider contact) of the three screws on the right-hand side of the control. The other end of this red lead is connected to the grid contact of the first R. F. socket.

A green lead is soldered to the lower one of the three screws. The other end of the green lead is soldered to a (ground) lug held under the right-hand bolt that clamps the R. F. amplifier assembly base to the metal frame. On earlier models the green lead is soldered to a lug under ground binding post.

Model 37 sets after Serial No. 1,265,000 employ a shielded antenna lead. The braided shield is clamped to the lower of the three screws on the right-hand side of the control, and the antenna lead (which runs inside the shield) is soldered to the center of the three screws. The other end of the shield is clamped to the ground terminal on the antenna-ground post bracket. The other end of the antenna lead is soldered to the antenna terminal on the bracket.

In Model 37 sets below Serial No. 1,265,000 the antenna post is mounted directly through the grid contact of the first R. F. socket. The ground post is held on a metal angle extending under the first R. F. socket.

Inspect the volume control carefully. If the resistance unit is damaged, replace with resistance unit No. 9788. Bend the slider so it will make firm contact with the resistance wire. Clean off the contact end of the slider and see that the top edge of resistance unit is free from dirt. If resistance unit is of old style with two sizes of wire, replace with new style (same part number) which has one size of resistance wire with increased spacing at one end. Also see that slider is of latest style.

When installing the new volume control, connect the leads in the manner specified above.

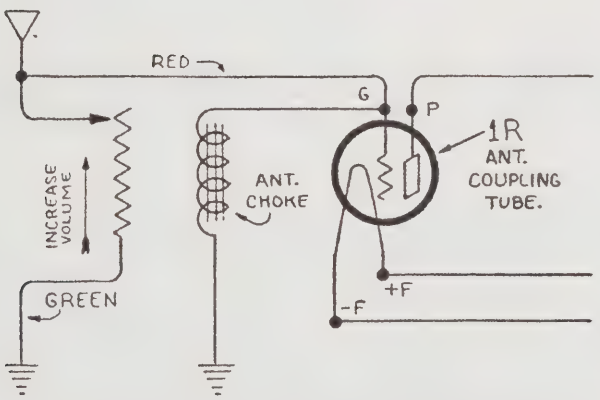


FIG. 60. SCHEMATIC DIAGRAM OF VOLUME CONTROL IN MODELS 37 AND 38.

Model 38 Set

General Description

Model 38 is a seven-tube, single dial, A. C. receiver, with a power unit incorporated in the metal cabinet that houses the set.

The circuit has four stages of radio frequency amplification (with double coil type R. F. transformers), a tuned detector, and two stages of audio frequency amplification. The first R. F. tube is not tuned and acts as an antenna coupling tube. The second A. F. stage is of the power type with condenser-choke coupling to the speaker.

Since the volume provided by this powerful set is ordinarily more than required for local reception, a special switch (the "local-distance" toggle switch), is provided on the front of the cabinet, to open the plate circuit of the second R. F. amplifying tube, thereby reducing the volume materially.

The volume control consists of an adjustable resistance connected from antenna to ground.

Removing Set from Cabinet

First remove cover from power unit by taking out the two screws at its lower outside ends, and four bolts at bottom of front. Lift cover off vertically, exposing set cable connection panel. Remove nuts from terminals which pass through holes in cable connection panel and lift off latter, releasing cable from power unit.

Remove the dial and vernier knob. Then unscrew the eight machine screws which clamp the chassis to the cabinet. All of these machine screws are reached from inside the cabinet; three are at each end in a vertical row, the seventh is near the center of the vertical side of the metal frame of the set, and the eighth is near the center of the horizontal side of the frame. A magnetized screw driver will be found of great assistance in removing and replacing these screws. Remove two screws holding antenna-and-ground post bracket on inside back of cabinet.

(Continued on page 58.)

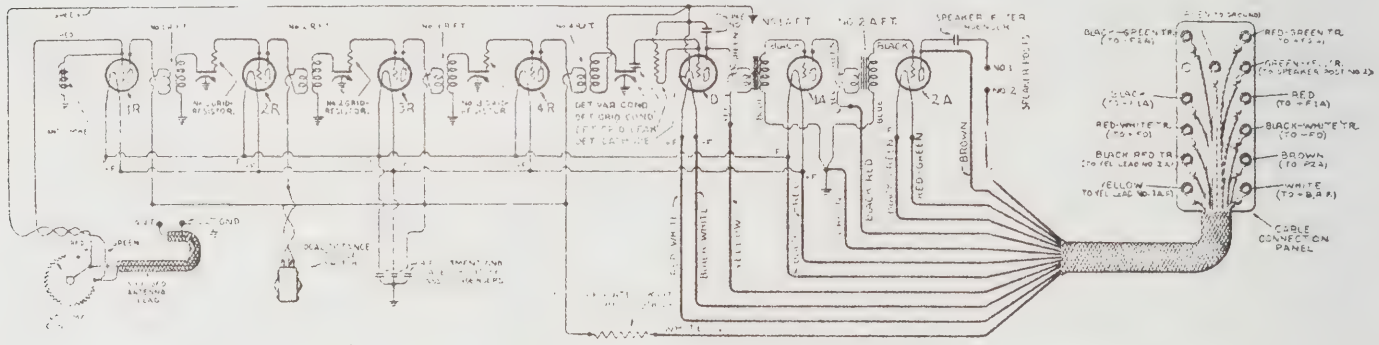


FIG. 61. WIRING DIAGRAM OF MODEL 38

A 2nd A. F. filament shunt resistance is used before Serial No. 1,752,000 and the green-yellow tracer cable lead is not used. Connections for this resistance are shown in dotted lines in the diagram on page 71. Note that the black and the red cable leads feed the R. F. filaments as well as the 1st A. F. filament. A schematic diagram of the volume control is shown in Fig. 60.

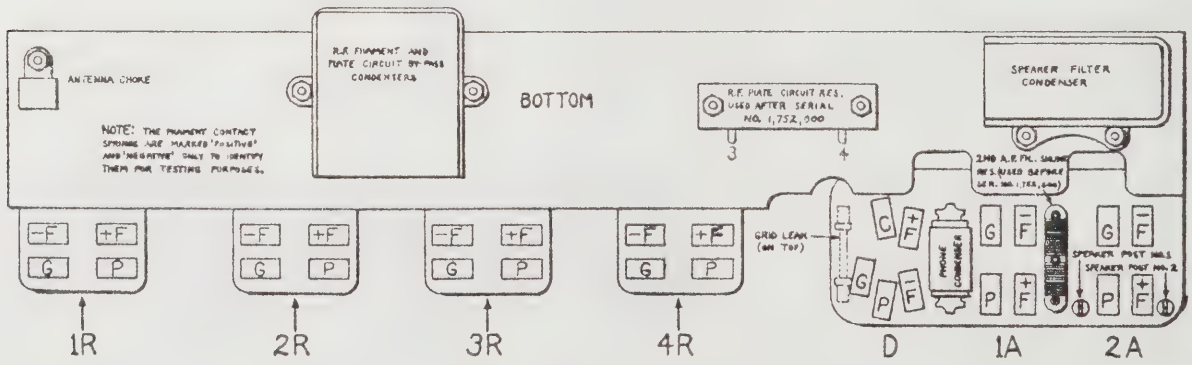


FIG. 62. TEST CHART FOR MODEL 38

Continuity Test Table—Model 38

Colors Refer to Cable Leads

For Following Tests Remove Cable Panel from Power Unit

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
Red-Green Tr. to +F2A Black-Green Tracer to —F2A Red-White Tr. to +FD Black-White Tracer to —FD Red to +F1A Black to —F1A Green-Yellow Tracer to Speaker Post No. 2. Green to Ground Post. Brown to P2A White to 4 (on R.F. Plate Resistance.) (After Serial No. 1,752,000.)	*Full*	Open in cable or connection.	Examine soldered connections at cable connection panel and set.
GREEN to			
P1A	*None*	Grounded 1st A.F. plate circuit.	
PD	*None*	Grounded detector plate circuit.	Or shorted phone condenser.
P3R	*None*	Grounded R.F. plate circuit.	Or shorted by-pass condenser.
+F3R, —F3R	*None*	Grounded R.F.-1st A.F. filament circuit.	Or shorted by-pass condenser.
+FD, —FD	*None*	Grounded detector filament circuit.	
+F2A, —F2A	*None*	Grounded 2nd A.F. filament circuit.	
G2R, G3R, G4R	*Partial*	None—Open grid resistance or secondary No. 1, 2, 3 R.F.T. Full—Shorted grid circuit.	Test across grid resistors separately. (Mounted on back of R.F. variable condensers.)
G1A	*Partial*	None—Open secondary No. 1 A.F.T.	Full—Shorted secondary.
G2A	*Partial*	None—Open secondary No. 2 A.F.T.	Full—Shorted secondary.
G1R (Volume Control Full Right.)	*Full*	None—Open antenna choke.	
Stator of Detector Variable Condenser.	*Full*	Open secondary last R.F.T.	
CD	*Full*	Open cathode lead.	
WHITE to			
3 (After Serial No. 1,752,000.)	*Partial*	None—Open R.F. plate circuit resistance.	Full—Shorted R.F. plate circuit res.
P1R, P2R, P3R, P4R ("Local-Distance" Switch "on.")	*Partial**	None—Open primary No. 1, 2, 3, 4 R.F.T.	No reading to P2R with switch "off."
YELLOW to			
PD	*Partial*	None—Open primary No. 1 A.F.T.	Full—Shorted primary No. 1 A.F.T.
Black-Red Tr. to P1A	*Partial*	None—Open primary No. 2 A.F.T.	Full—Shorted primary No. 2 A.F.T.
OTHER TESTS			
GD to Stator of Last Variable Condenser.	*None*	Shorted grid condenser.	Mounted on back of det. var. cond.
P2A to Speaker Post No. 1.	*None*	Shorted speaker filter condenser.	
G1R to Antenna Post.	*Full*	Open antenna connection.	
Speaker Post No. 2 to —F2A, +F2A. (Before Serial No. 1,752,000.)	*Full*	Open connection or open 2nd A.F. Filament shunt resistance.	
To Test Volume Control, Unsolder Connection from Antenna Choke to G1R and Test from Antenna to Ground Post, Turning Knob.	*Smooth and Nearly Full*	No reading—open in resistance winding. Erratic reading—damaged resistance wire or slider.	If found defective, repair or install new control. Resolder antenna choke lead.

*NOTE.—The reading from WHITE to each R. F. plate is "full" in Model 38 sets, prior to Serial No. 1,752,000

When the screws have been removed pull the set straight back horizontally so that the condenser shaft and volume control clear the cabinet and then lift the set up carefully and rest it on top of the cabinet while removing the "local-distance" toggle switch from the front of the cabinet. Loosen hexagon nut on toggle switch with an open-end wrench and unscrew knurled lock nut from front of toggle switch with fingers. Never use a wrench or pliers on the knurled nut.

Replacing Variable Condensers

If one variable condenser is defective, replace entire group of four variable condensers.

No. 13210 for Model 38 sets below Serial No. 1,752,000.

No. 13200 for Model 38 sets above Serial No. 1,752,000.

Use pulleys and belts of original group.

Procedure: Loosen twelve screws holding variable condensers to metal frame. Note how pulleys and belts are arranged and then remove them. Replace one condenser at a time.

Remove the double R. F. transformers which are mounted on backs of variable condensers (do not unsolder transformer leads), at the same time removing the grid resistors, the grid condenser and the lugs of secondary leads, which are held to the condensers by the same nuts that hold the R. F. transformer brackets.

Remove the three screws holding first condenser, lift out the condenser and put in replacement without tightening screws. Mount the first R. F. transformer, the first grid resistor and the secondary lead lug, on the two bolts on back of the condenser. Make certain that the axes or long sides of the transformer coils are vertical. This may be checked by seeing that the sides of the coils are parallel to the vertical metal strip on the back of the condenser.

Repeat procedure with each condenser and, when all four are in place, put on the pulleys and belts, adjust belt tension and synchronize condensers. (See Section XI.)

Replacing R. F. Transformers

If one double R. F. transformer is defective, replace entire group of four double R. F. transformers. Part No. 13220.

One lead on each transformer has a distinctive color, as follows:

No. 1 has a white lead.

No. 2 has a green lead.

No. 3 has a yellow lead.

No. 4 has a blue lead.

Procedure: In replacing double R. F. transformers, substitute one transformer at a time, mounting and connecting the replacement exactly like the original. Do not mix up the old coils with the replacements.

Remove two nuts on back of first variable condenser which hold R. F. transformer brackets, unsolder transformer connections and remove old transformer. Put replacement transformer in position, seeing that the grid resistor and lug of secondary lead are replaced properly, and tighten the two nuts. The transformer angle brackets must be arranged so that the axes or long sides of the coil are vertical. This may be checked by seeing that the long sides of the coils are parallel to the vertical metal strip on the back of the variable condenser. Solder leads exactly like the original.

Repeat procedure with each R. F. transformer.

Replacing Volume Control (No. 13,018)

In replacing the volume control, the chassis must be removed from the cabinet.

The control is held to the chassis by two screws and nuts, and it is mounted in such a way that the terminals of the control are at the right-hand side when looking at the chassis in its normal position. Remove the two screws, holding the bottom nut with a long-nose pliers as this nut is somewhat closed in by the first A. F. transformer.

A red lead is soldered to the center (slider contact) of the three screws on the right hand side of the control. The other end of this red lead is connected to the grid contact of the first R. F. socket.

A green lead is soldered to the lower one of the three screws. The other end of this green lead is soldered to a (ground) lug held under the right hand one of the two screws that clamp the fourth R. F. socket to the metal frame.

The lead from the antenna post is run through a braided metal shield and connects to the center of the three screws on the volume control. One end of the braided shield is clamped to the lower one of the three screws on the volume control and the other end

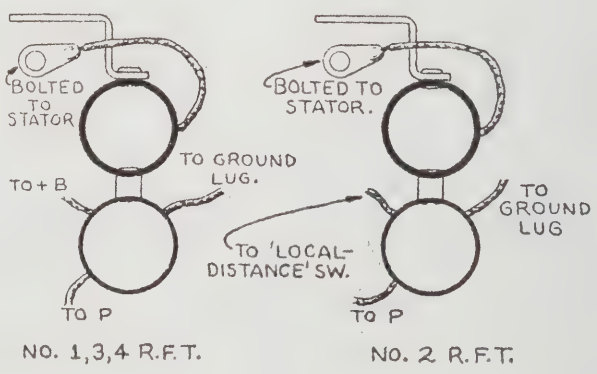


FIG. 63. SKETCH SHOWING CONNECTIONS FROM R. F. TRANSFORMERS

is clamped to the ground post. The antenna and ground posts are mounted on a small bracket that is screwed inside the back of the cabinet.

Inspect the volume control carefully. If the resistance unit is damaged, replace with resistance unit No. 9788. Bend the slider so it will make firm contact with the resistance wire. Clean off the contact end of the slider and see that the top edge of the resistance unit is free from dirt. If resistance unit is of old style with two sizes of wire, replace with new style (same part number) having one size of wire with increased spacing at one end. Also see that slider is of latest style.

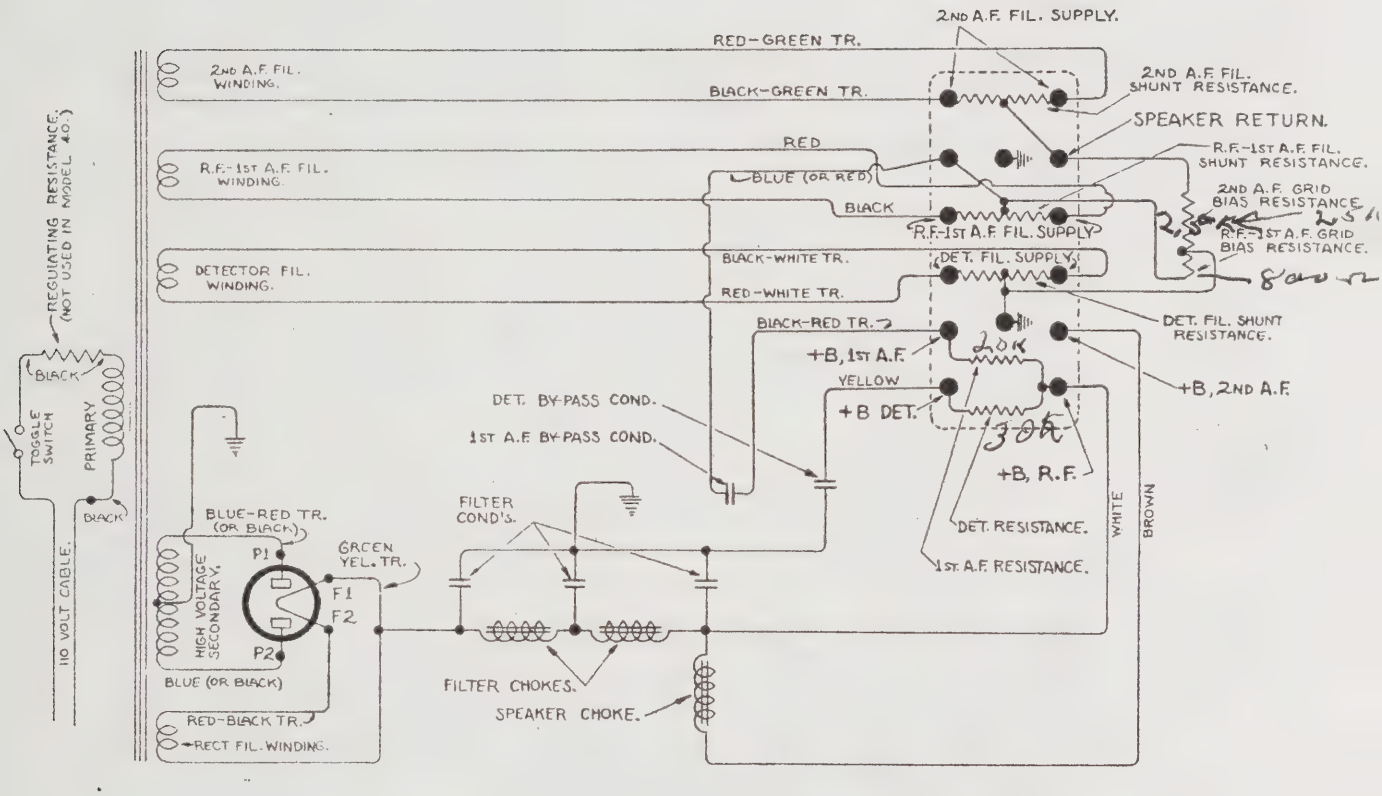


FIG. 63-A. SCHEMATIC DIAGRAM OF POWER UNIT IN MODELS 40, 42, 44, AND 52. SEE PAGE 69 FOR DESCRIPTION OF THIS UNIT. SOME EARLY UNITS OF THIS TYPE HAVE COLOR SCHEME SIMILAR TO UNIT IN MODEL 38 SET. NOTE THAT COLORS AS NOW STANDARDIZED CORRESPOND WITH THE COLORS OF SET-CABLE LEADS.

Power Units in Models 37 and 38 Sets

General Description

Power units in Models 37 and 38 receiving sets are mounted inside the metal cabinet of the set. The units are encased in a metal cover which has an opening in the left hand end of the top for insertion of the rectifier tube.

The power unit is designed for operation on 110 volt, alternating current, and furnishes complete filament, plate and grid voltages to the set.

The unit has two metal containers, one for the power transformer and one for the condensers and chokes.

Information about Atwater Kent power units is given in the Section I of this Manual.

Removing Unit from Cabinet

Remove the cover and cable connection panel from the power unit and remove the set itself from the cabinet. (See instructions for removing 37 set chassis from cabinet). Then remove the A. C. toggle switch by loosening the hexagonal nut with an open-end wrench, unscrewing the front knurled lock-nut with the fingers. Never use a wrench or pliers on the knurled nut, as it will scratch up the nut and probably mar the finish of the cabinet. Note that the toggle switch leads come from the right hand side of the cabinet; arrange the switch in the same way when replacing so it will be "on" when the button is pushed to the right.

The power unit is held to the cabinet by three screws at each end, two of the six screws being the two rear

(Continued on page 62.)

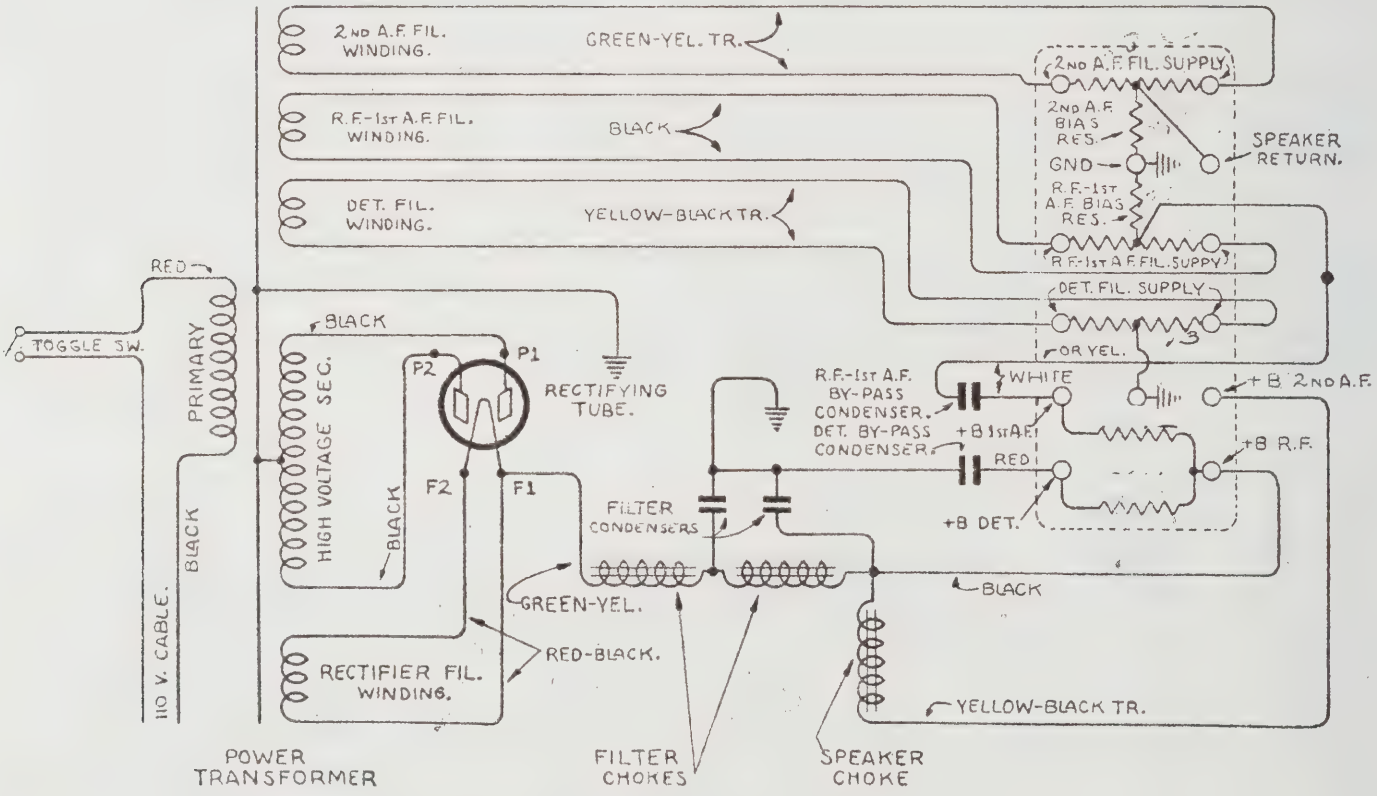


FIG. 64. DIAGRAM OF POWER UNIT IN MODELS 37 AND 38

The diagram of the power unit in Models 40, 42, 44 and 52 is similar to that shown above with the following exceptions: A regulating resistance is connected in series with the primary circuit in Models 42, 44 and 52. A filter condenser is connected between F1 and ground. The junction point of the bias resistance is connected to the lower instead of the upper ground eyelet. The color scheme is different and is shown in Fig. 77.

Continuity Test Table and Chart—Power Unit for Models 37 and 38

For Following Tests Remove Cable Panel from Power Unit

TEST	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
Across 2nd A.F. Filament Supply.	*Full*	None—Open 2nd A.F. fil. winding and open 2nd A.F. filament shunt resistance.	Nearly full—open filament winding. (Unsolder one fil. winding connection and test winding and fil. shunt resistance separately.)
Across R.F.-1st A.F. Filament Supply.	*Full*	None—Open R.F.-1st A.F. fil. winding and open R.F.-1st A.F. fil. shunt res.	Nearly full—open filament winding. (Unsolder one fil. winding connection and test winding and fil. shunt resistance separately.)
Across Detector Filament Supply.	*Full*	None—Open det. fil. winding and open detector filament shunt resistance.	Nearly full—open filament winding. (Unsolder one fil. winding connection and test winding and fil. shunt resistance separately.)
FROM +B R.F. to			
+B 2nd A.F.	*Partial*	None—Open speaker (output) choke.	Full—Shorted speaker choke.
+B 1st A.F.	*Small*	None—Open 1st A.F. plate circuit res.	
+B Detector.	*Very Small*	None—Open detector plate circuit res.	
Ground.	*None*	Shorted filter condenser.	
F1 (on Rectifier Tube Socket.)	*Partial*	None—Open plate supply filter choke.	
FROM GROUND to			
+B Detector.	*None*	Shorted by-pass condenser.	
One Side of 2nd A.F. Filament Supply.	*Partial*	None—Open 2nd A.F. grid bias resistance.	Full—Shorted bias resistance.
One Side of R.F.-1st A.F. Filament Supply.	*Partial*	None—Open R.F.-1st A.F. grid bias resis.	Full—Shorted bias resistance.
One Side of Detector Filament Supply.	*Full*	Open connection to center-tap of detector filament shunt resistance.	Examine connections under panel assembly.
+B 1st A.F.	*None*	Shorted by-pass condenser.	
P1, P2 (on Rectifier Tube Socket.)	*Nearly Full*	None—Open high voltage sec. winding.	
Each Terminal of A.C. Plug.	*None*	Grounded primary of power transformer.	Inspect A.C. cable and switch leads for accidental grounds.
OTHER TESTS			
Across Terminals of A. C. Plug. (Toggle Switch "On.")	*Full*	Open primary of transformer or open cable or switch leads.	
F1 to F2 (on Rectifier Tube Socket.)	*Full*	Open rectifier filament winding or connections.	
One Side of 2nd A.F. Filament Supply to Speaker Return Terminal.	*Full*	Open connection to center-tap of 2nd A.F. filament shunt resistance.	

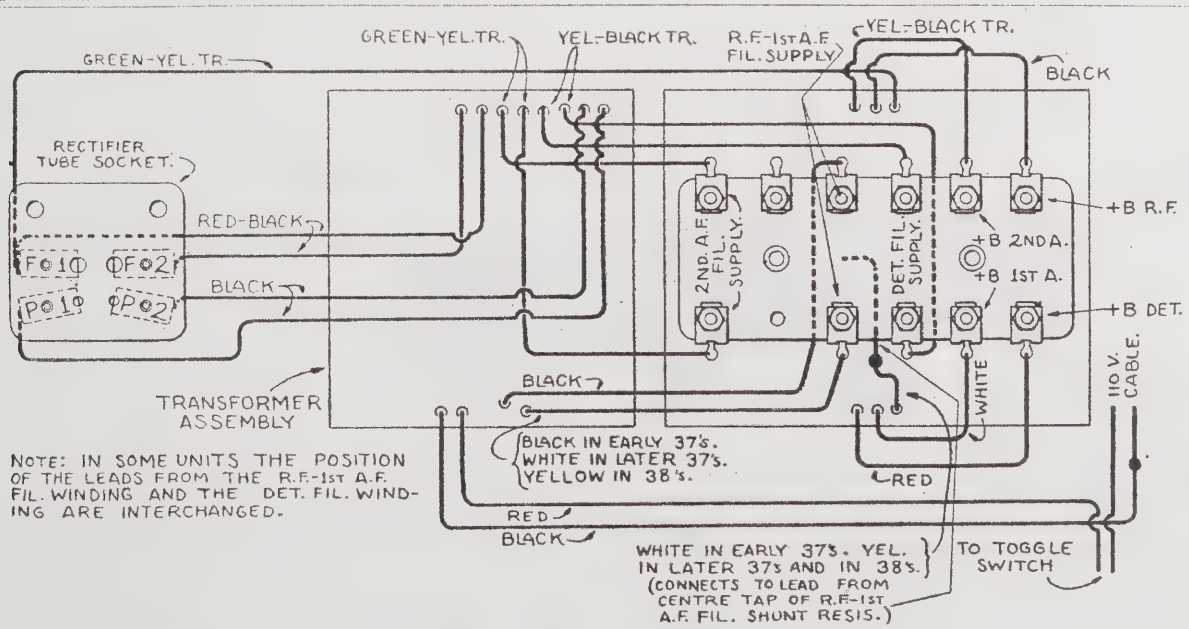


FIG. 65. SHOWING CONNECTIONS FROM TRANSFORMER AND CONDENSER-CHOKE ASSEMBLIES TO PANEL ASSEMBLY

This view shows the approximate position of leads from the metal containers. In replacement condenser-choke assemblies for Model 38 the lead to +B first A. F. terminal is sometimes black-red tracer instead of white.

felt-headed feet of the cabinet. The transformer and condenser-choke sections are held to the base of the power unit by three long bolts and a single heavy metal strap. The panel assembly is fastened to the metal strap by two screws and nuts—one the ground terminal and the other at the center toward the opposite end of the panel assembly.

Note that a bare braided wire comes from each metal container and that these wires are soldered to lugs which are fastened to two of the long bolts.

Testing

Apply the continuity tests given in the table. If the tests indicate that one section of the unit is defective, replace that section, connecting it exactly as the original.

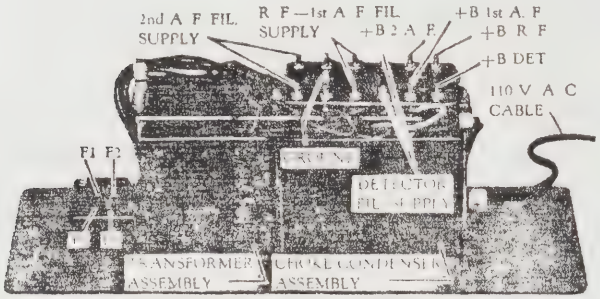


FIG. 66. POWER UNIT IN MODELS 37 AND 38. COVER REMOVED

The unit illustrated is for a Console 37 and the two terminals on either side of the ground terminal are used for toggle switch connection in the 110 volt line.

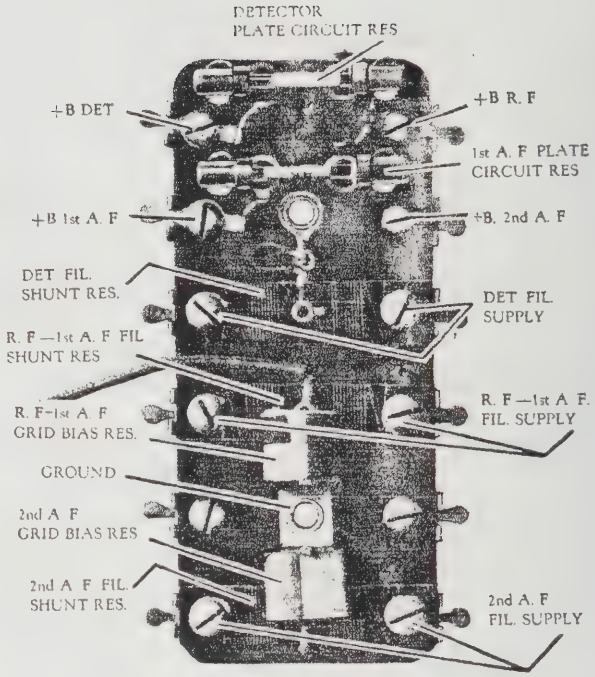


FIG. 67. REAR VIEW OF PANEL ASSEMBLY ON MODELS 37, 38 AND LATER TYPE "Y" POWER UNITS

The terminal on the right hand side of the ground eyelet is used as "speaker-return" terminal on later Models 37 and 38 sets. In Model 37 Console sets, and in later type "Y" power units, the terminals on either side of the ground eyelet are used for toggle switch connection in the 110 volt line.

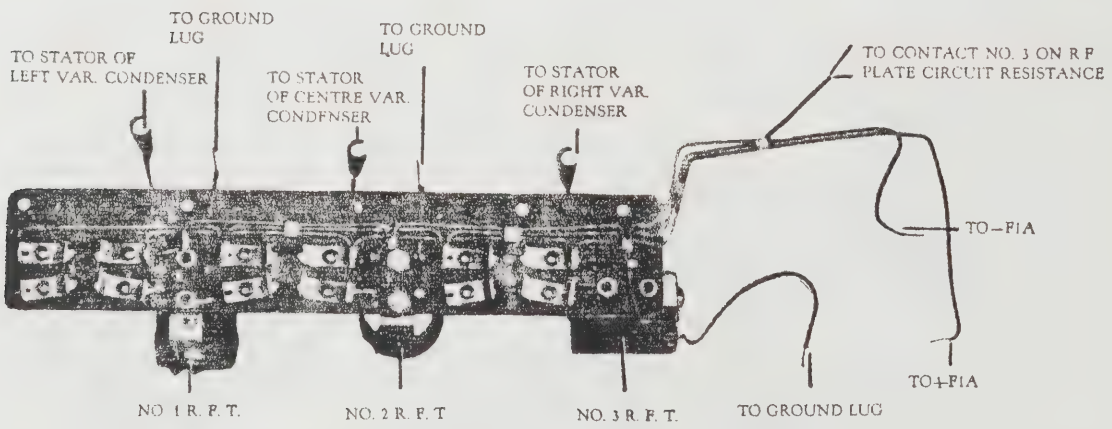


FIG. 68. VIEW OF R. F. AMPLIFIER ASSEMBLY IN MODELS 40, 42 AND 52, SHOWING WHERE EACH LEAD IS TO BE CONNECTED

General Description

The Models 40, 42 and 52 are six-tube single-dial A. C. receivers with complete power unit incorporated in the metal cabinet that houses the set. The power unit operates from 110 volt, alternating current, and supplies complete filament, plate and grid voltages to the set. The power unit is sealed in a single metal container.

Models 42 and 52 are equipped with an automatic voltage regulator in series with one side of the A. C. line. This device is so designed that owing to the heating effect, a voltage above normal (110) will increase its resistance value, and a voltage below normal will decrease its resistance, so that the voltage across the primary of the transformer is maintained at a constant value.

The circuit of each set has three stages of radio frequency amplification, the first stage acting as a coupling tube in order to eliminate the detuning effect of different antenna sizes (which would otherwise disturb the synchronism of the three tuned circuits). There is a tuned detector and two stages of audio frequency amplification.

The volume control consists of a resistance connected across a section of the antenna coupling transformer. A slider on this resistance connects to ground, and the antenna is connected to one side of the resistance. By adjusting the slider, more or less of the antenna current may be shunted to ground, thus decreasing or increasing the volume.

Model 52 has a metal cabinet about thirty inches high, with a cone speaker mounted in the lower section of the cabinet.

Removing Set from Cabinet

Lift off the cover of the power unit and remove the nuts from posts which pass through the holes in cable connection panel, releasing the cable from power unit.

Remove dial and vernier knob. Remove two screws which hold antenna-and-ground post bracket on inside back of cabinet. (Model 52 does not have this bracket.) Remove the six screws, three in a vertical row at each end, which clamp the chassis to the inside front of cabinet. Pull chassis straight back horizontally to allow condenser shaft and volume control to clear front of cabinet, then lift set up and out.

In Model 52 pull up the antenna and ground leads and remove speaker leads from posts on set.

Replacing Variable Condensers

If one variable condenser is defective, replace entire group of three condensers. Use pulleys and belts of original group.

Procedure: Remove set from cabinet. Loosen nine screws holding condensers to front of metal frame. Note how pulleys and belts are arranged and then remove them. Replace one condenser at a time. Do not mix old condensers with the replacements.

Remove two nuts on back of first variable condenser, which clamp grid resistor (grid condenser on last variable condenser) and lug of secondary lead. Remove three screws holding condenser to chassis and lift out the condenser.

Put in the replacement condenser and its three screws, without tightening screws, attach grid resistor and lug of secondary lead to top and bottom bolts respectively on back of condenser. Repeat procedure with other two variable condensers. When the replacement condensers are installed, put on the pulleys and belts, adjust belt tension and synchronize condensers (see Section XI).

Replacing R. F. Transformers

If one R. F. transformer is defective, replace R. F. amplifier assembly. (See Fig. 68.) The R. F. amplifier assembly consists of three R. F. transformers mounted on a three-socket moulded base. The filament contacts are wired and have two leads for connection to filament contacts of first A. F. socket. The plate circuits are wired and have one lead for connection to the left hand contact (No. 3) on the R. F. plate circuit resistance. A lead from the grid end of each R. F. transformer is soldered to a lug which is to be fastened to the bottom bolt on back of the variable condenser immediately in front of each R. F. transformer. The three return-leads from secondaries of each R. F. transformer are to be soldered to ground lugs which are held by bolts that clamp the R. F. amplifier base to the frame of set.

In replacing R. F. amplifier assembly, the chassis must be removed from the cabinet. Unsolder three leads from by-pass condenser, lead from grid contact of the first R. F., socket, leads from the grid resistors (unsolder at grid contacts of sockets), two filament circuit leads (at filament contacts of first A. F. socket), and the +B, R. F. lead. Remove secondary wire lug from bottom bolt on each variable condenser. Unsolder, at grid contact, the lead from grid condenser, which passes through a hole in the R. F. base. Unsolder three leads from secondaries of R. F. transformers where they are soldered to lugs under bolts holding R. F. base to metal frame. Remove five bolts holding R. F. base to metal chassis and remove the old R. F. amplifier assembly.

Reassemble with replacement R. F. amplifier, reversing above procedure.

Replacing Volume Control

Remove chassis from cabinet.

The volume control is held to the metal frame by two screws and nuts and is mounted in such a way that the three terminals are on the right hand side when looking at the chassis in its normal position. Remove the two screws, using a long-nose pliers to grip the bottom nut, which is close to the second A. F. transformer.

(Continued on next page.)

A yellow lead connects the top one of the three terminals to the inside end of the antenna coupling transformer.

A red lead connects the bottom one of the three terminals to the tap on the antenna coupling transformer.

A green lead runs from the center terminal (slider contact) to a (ground) lug held under the right hand bolt that clamps the base of the R. F. amplifier assembly to the metal frame.

The lead from the antenna post runs through a braided metal shield and is soldered to the lower one of the three terminals on the volume control. The metal braid is clamped to the center one of the three terminals. The other end of the metal braid is clamped to the ground post.

Model 52 does not have the shielded antenna lead. In this set two twenty-foot leads are connected to the volume control, black for antenna, and black-green tracer for ground.

(The outside end of the antenna coupling transformer is connected to the grid contact of the first R. F. socket).

Inspect the volume control carefully. If the resistance unit is damaged, replace with latest style of resistance unit. Bend the slider so it makes firm contact with resistance wire. Clean the contact end of the slider and the top edge of the resistance unit. See that slider is of latest type.

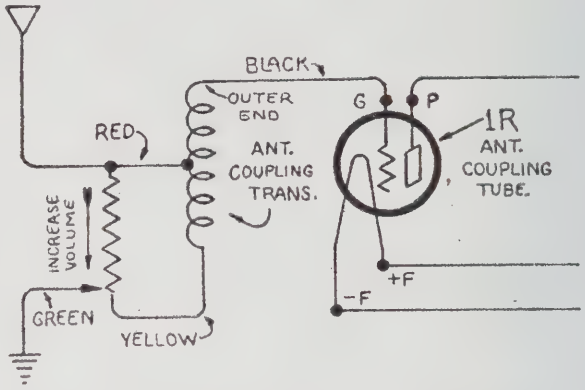


FIG. 69. SCHEMATIC DIAGRAM OF VOLUME CONTROL, MODELS 40, 42, 44 AND 52

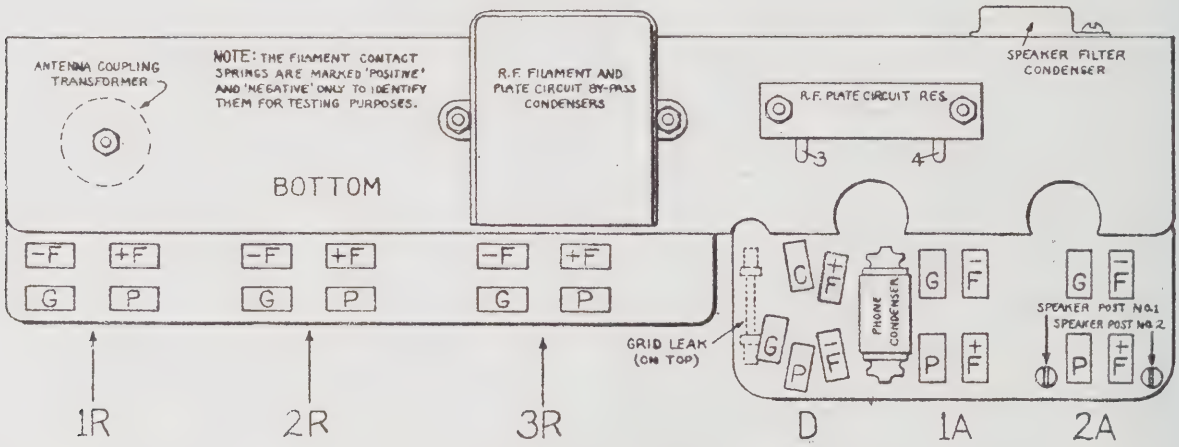


FIG. 70. TEST CHART FOR MODELS 40, 42, 52

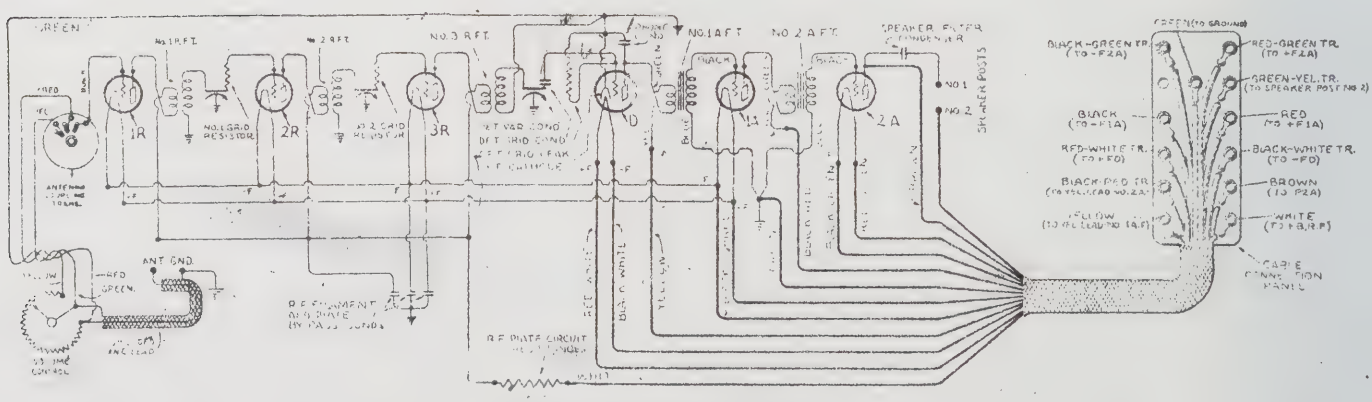


FIG. 71. WIRING DIAGRAM OF MODELS 40, 42 AND 52

Model 52 does not have the shielded antenna lead, but is provided with two twenty-foot leads which are connected to the volume control, black for antenna and black-green tracer for ground.

Continuity Test Table—Models 40, 42 and 52

Colors Refer to Cable Leads

For Following Tests Remove Cable Panel from Power Unit

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
Red-Green Tr. to +F2A Black-Green Tracer to —F2A Red-White Tr. to +FD Black-White Tracer to —FD Red to +F1A Black to —F1A Green-Yellow Tracer to Speaker Post No. 2. Green to Ground Post. Brown to P2A. White to 4 (on R.F. Plate Resistance).	*Full*	Open in cable or connection.	Examine soldered connections at cable connection panel and set.
GREEN to			
P1A	*None*	Grounded 1st A.F. plate circuit.	
PD	*None*	Grounded detector plate circuit.	Or shorted phone condenser.
P3R	*None*	Grounded R.F. plate circuit.	Or shorted R.F. by-pass condenser.
+F3R, —F3R	*None*	Grounded R.F.-1st A.F. filament circuit.	Or shorted R.F. by-pass condenser.
+FD, —FD	*None*	Grounded detector filament circuit.	
+F2A, —F2A	*None*	Grounded 2nd A.F. filament circuit.	
G2R, G3R	*Partial*	None—Open grid resistor or secondary No. 1, 2 R.F.T. Full—Shorted grid circuit.	Test across resistors and secondaries separately. (Resistors mounted on back of R.F. var. conds.)
G1R	*Full*	Open antenna coupling transformer.	Volume control full right.
G1A	*Partial*	None—Open secondary No. 1 A.F.T.	Full—Shorted secondary.
G2A	*Partial*	None—Open secondary No. 2 A.F.T.	Full—Shorted secondary.
Stator of Detector Variable Condenser	*Full*	Open secondary last R.F.T.	
CD	*Full*	Open cathode lead.	
WHITE to			
3 (on R.F. Plate Res.)	*Partial*	None—Open R.F. plate circuit resistance.	Full—Shorted R.F. plate circuit res.
P1R, P2R, P3R.	*Partial*	Open primary No. 1, 2, 3 R.F.T.	
YELLOW to			
PD	*Partial*	None—Open primary No. 1 A.F.T. (or open in cable connection).	Full—Shorted primary.
Black-Red Tracer to			
P1A	*Partial*	None—Open primary No. 2 A.F.T. (or open in cable connection).	Full—Shorted primary.
OTHER TESTS			
GD to Stator of Last Condenser.	*None*	Shorted grid condenser.	Mounted on back of det. var. cond.
P2A to Speaker Post No. 1.	*None*	Shorted speaker filter condenser.	
G1R to Ant. Terminal.	*Full*	Open antenna connection.	
To Test Volume Control, Unsolder Red Lead from Antenna Coupling Transformer and Test Across Antenna and Ground Terminals, Turning Control Knob.	*Smooth and Nearly Full*	No reading—open resistance winding. Erratic reading—damaged resistance winding or slider.	If found defective, repair or install new control. Resolder red lead.

Model 44 Set

General Description

Model 44 set is similar to the Model 38 in design, but with the same improvements as contained on the Model 42, that is, newly designed cabinet, antenna coupling transformer and automatic voltage regulator. The power unit of Model 44, as in Models 40, 42 and 52, is sealed in a single metal container. Model 44 also contains the "local-distance" switch which is featured in the Model 38, but in Model 44, this switch cuts out a part of the primary of the second R. F. T.

The circuit has four stages of radio frequency amplification (with double-coil type R. F. transformers), a tuned detector, and two stages of audio frequency amplification. The first R. F. tube acts as an antenna coupling tube. The second A. F. stage is of the power type with condenser-choke coupling to the speaker.

The volume control consists of a resistance connected across a portion of the antenna coupling transformer. The slider on this resistance connects to ground, and the antenna connects to one end of the resistance. By turning the slider (ground) toward the antenna end of the resistance, the volume is decreased.

Removing Set from Cabinet

Lift off the cover of power unit and remove nuts from posts which pass through holes in the cable connection panel, releasing the cable. Remove dial and vernier knob. Remove two screws which hold antenna-and-ground post bracket on back of cabinet.

As in the Model 38, the chassis of the Model 44 is held to the cabinet by eight machine screws, all reached from inside the cabinet. Three screws are in a vertical

(Continued on page 68.)

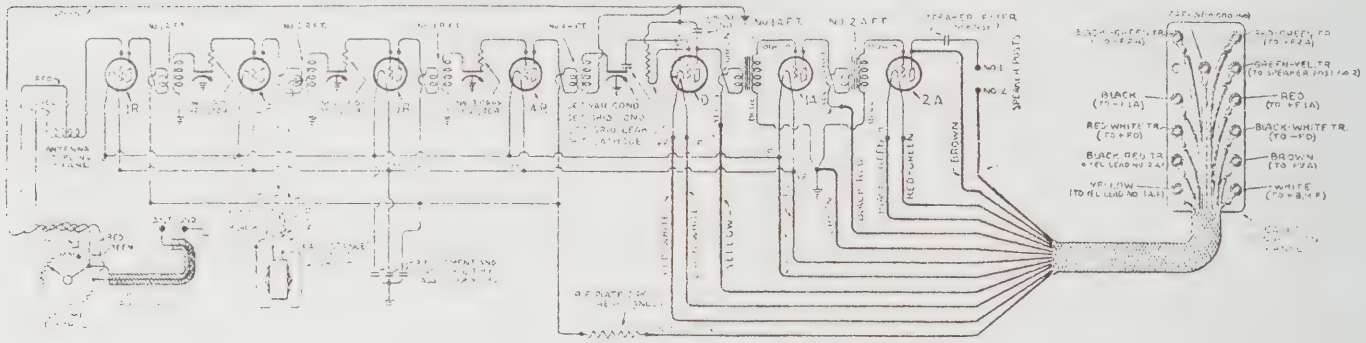


FIG. 72. WIRING DIAGRAM OF MODEL 44

A schematic diagram of the volume control is shown in Fig. 69. The ground connection to the R. F. by-pass condensers, in this and other models, is made through the metal container in which the condensers are sealed. A pictorial representation of the antenna coupling transformer is shown in Fig. 71.

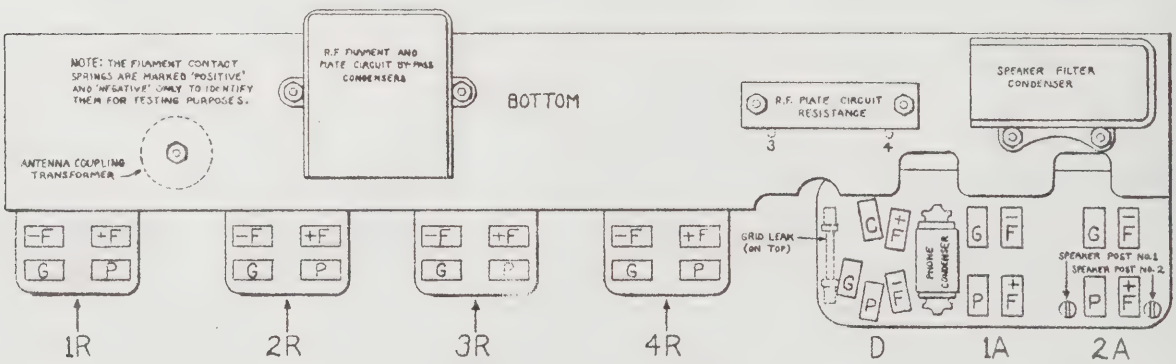


FIG. 73. TEST CHART FOR MODEL 44

Continuity Test Table—Model 44

Colors Refer to Cable Leads

For Following Tests Remove Cable Panel from Power Unit

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
Red-Green Tr. to +F2A Black-Green Tracer to —F2A Red-White Tr. to +FD Black-White Tracer to —FD Red to +F1A Black to —F1A Green-Yellow Tracer to Speaker Post No. 2. Green to Ground Post. Brown to P2A White to 4 (on R.F. Plate Resistance.)	*Full*	Open in cable or connection.	Examine soldered connections at cable connection panel and set.
GREEN to			
P1A	*None*	Grounded 1st A.F. plate circuit.	
PD	*None*	Grounded detector plate circuit.	Or shorted phone condenser.
P3R	*None*	Grounded R.F. plate circuit.	Or shorted by-pass condenser.
+F3R, —F3R	*No*	Grounded R.F.-1st A.F. filament circuit.	Or shorted by-pass condenser.
+FD, —FD	*None*	Grounded detector filament circuit.	
+F2A, —F2A	*None*	Grounded 2nd A.F. filament circuit.	
G2R, G3R, G4R	*Partial*	None—Open grid resistance or secondary No. 1, 2, 3 R.F.T. Full—Shorted grid circuit.	Test across grid resistors separately. (Mounted on back of R.F. variable condensers.)
G1A	*Partial*	None—Open secondary No. 1 A.F.T.	Full—Shorted secondary.
G2A	*Partial*	None—Open secondary No. 2 A.F.T.	Full—Shorted secondary.
G1R	*Full*	None—Open antenna coupling transformer.	Volume control full right.
Stator of Detector Variable Condenser.	*Full*	Open secondary last R.F.T.	
CD	*Full*	Open cathode lead.	
WHITE to			
3 (on R.F. Plate Res.)	*Partial*	None—Open R.F. plate circuit resistance.	Full—Shorted R.F. plate circuit res.
P1R, P2R, P3R, P4R ("Local-Distance" Switch Up.)	*Partial*	None—Open primary No. 1, 2, 3, 4 R.F.T.	Partial reading to P2R with "Local-distance" switch down.
YELLOW to			
PD	*Partial*	None—Open primary No. 1 A.F.T.	Full—Shorted primary No. 1 A.F.T.
Black-Red Tr. to P1A	*Partial*	None—Open primary No. 2 A.F.T.	Full—Shorted primary No. 2 A.F.T.
OTHER TESTS			
GD to Stator of Last Variable Condenser.	*None*	Shorted grid condenser.	Mounted on back of det. var. cond.
P2A to Speaker Post No. 1.	*None*	Shorted speaker filter condenser.	
G1R to Antenna Post.	*Full*	Open antenna connection.	
To Test Volume Control, Unsolder Red Lead from Antenna Coupling Transformer and Test Across Antenna and Ground Terminals, Turning Control Knob.	*Smooth and Nearly Full*	No reading—open in resistance winding. Erratic reading—damaged resistance wire or slider.	If found defective, repair or install new control. Resolder red lead.

row at each end, the seventh is near the center of the horizontal side of the metal frame of set, and the eighth is near the center of the vertical side of the metal frame. Remove these screws, pull the set straight back, so the condenser shaft and volume control clear the cabinet and then lift the set up and rest it on top of the cabinet while removing the "local-distance" toggle switch from front of cabinet. Remove switch by loosening hexagonal nut with an open end wrench and unscrewing front knurled lock nut with fingers. Never use a wrench or pliers on the knurled nut.

Replacing Variable Condensers

If one variable condenser is defective, replace entire group of four variable condensers. Use pulleys and belts of original group.

Procedure: Remove set from cabinet. Loosen twelve screws holding variable condensers to metal frame. Note how pulleys and belts are arranged and then remove them. Replace one condenser at a time.

Remove the double R. F. transformers which are mounted on backs of variable condensers (do not unsolder transformer leads), at the same time removing the grid resistors, the grid condenser and the lugs of secondary leads, which are held to the condensers by the same nuts that hold the R. F. transformer brackets.

Remove the three screws holding first condenser, lift out the condenser and put in replacement without tightening screws. Mount the 1st R. F. transformer, the first grid resistor and the secondary lead lug, on the two bolts on back of the condenser. Make certain that the axes or long sides of the transformer coils are vertical. This may be checked by seeing that the sides of coils are parallel to the vertical metal strip on the back of the condenser.

Repeat procedure with each condenser and when all four are in place, put on the pulleys and belts, adjust belt tension and synchronize condensers (see Section XI).

Replacing R. F. Transformers

If one double R. F. transformer is defective, replace entire group of four R. F. transformers.

Procedure: Remove set from cabinet. In replacing Double R. F. transformers, substitute one transformer at a time, mounting and connecting the replacement exactly like the original. Do not mix up the old coils with the replacements.

Remove two nuts on back of first variable condenser which hold R. F. transformer brackets, unsolder transformer connections and remove old transformer Put replacement transformer in position, seeing that the grid resistor and lug of secondary lead are replaced properly, and tighten the two nuts. The transformer angle brackets must be arranged so that the axis or long side of the coil is vertical. This may be checked by seeing that the long sides of the coils are parallel to the vertical metal strip on the back of the variable condenser. Solder leads exactly like the original.

Repeat procedure with each R. F. transformer.

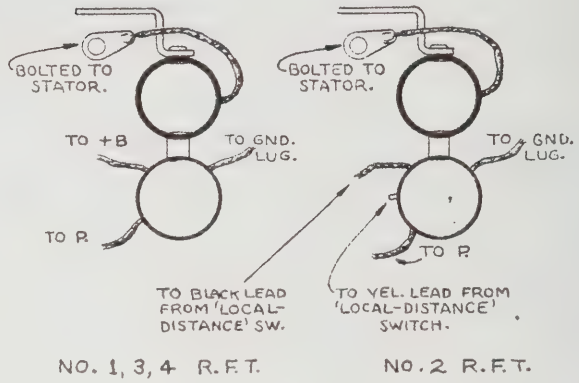


FIG. 74. SKETCH SHOWING CONNECTIONS FROM R. F. TRANSFORMERS

Replacing Volume Control

Remove chassis from cabinet.

The volume control is held to the metal frame by two screws and nuts and is mounted in such a way that the three terminals are on the right hand side when looking at the chassis in its normal position. Remove the two screws, using a long-nose pliers to grip the bottom nut, which is close to the second A. F. transformer.

A yellow lead connects the top one of the three terminals to the inside end of the antenna coupling transformer.

A red lead connects the bottom one of the three terminals to the tap on the antenna coupling transformer.

A green lead runs from the center terminal (slider contact) to a (ground) lug held under the right hand bolt that clamps the fourth R. F. socket to the metal frame.

The lead from the antenna post runs through a braided metal shield and is soldered to the lower one of the three terminals on the volume control. The metal braid is clamped to the center one of the three terminals. The other end of the metal braid is clamped to the ground post.

(The outside end of the antenna coupling transformer is connected to the grid contact of the first R. F. socket).

Inspect the volume control carefully. If the resistance unit is damaged, replace with latest style resistance unit. Bend the slider so it makes firm contact with the resistance wire. Clean the contact end of the slider and the top edge of the resistance unit. See that slider is of latest type.

Power Units in Models 40, 42, 44 and 52 Sets

Power units in Models 40, 42, 44 and 52 are very much like the later type "Y," the 37 and the 38 power units, the greatest difference being that all parts, with the exception of the panel assembly and tube socket, are sealed in a single container. The grid bias resistances are wound on a long strip instead of in two small separate sections. Models 42, 44 and 52 also have a regulating or ballast resistance in series with the primary of the power transformer. This resistance automatically compensates for line voltage variations and fluctuations.

Removing Power Unit from Cabinet

The power units in Models 40, 42, 44 and 52 receiving sets are sealed in a single metal container which is fastened inside the set cabinet by two screws at each end of the bottom and three screws at the top of the back. The rectifier tube socket is mounted on an angle bracket at the left hand end of the power unit. The panel assembly is fastened to the unit by two bolts and nuts which pass through the grid bias resistance strip. One of these bolts is the ground terminal.

Remove the cover or lid of the power unit (it is not screwed down) and release the cable connection panel from the panel assembly. Then remove set chassis from the cabinet. (See instructions for removing 40, 42, 44 and 52 receiving sets from cabinets). Loosen hexagon nut on A. C. toggle switch and unscrew front knurled lock nut with fingers. Note that the leads to the toggle switch come from the right, so that the switch is "on" when the toggle is thrown to the right.

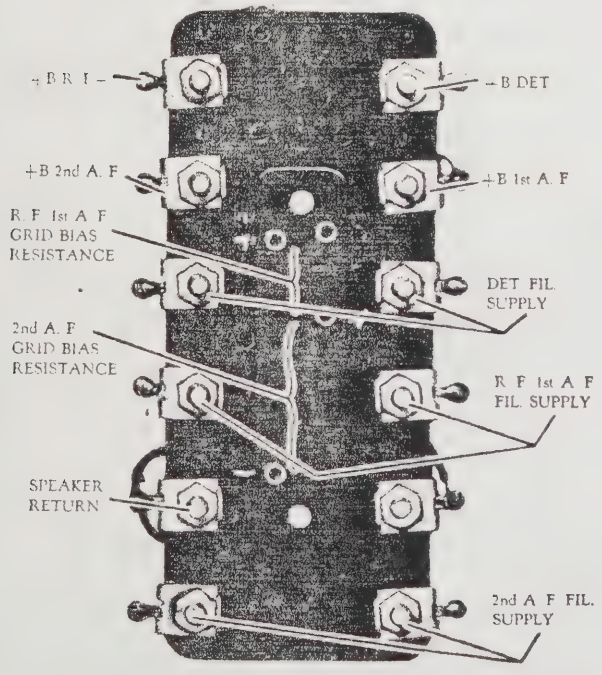


Fig. 75. Top View of Panel Assembly Used in Power Unit of Models 40, 42, 44 and 52

Remove screws holding power unit and remove two screws on strap which holds the 110 volt cable and the switch leads. The power unit may then be lifted out, pulling the 110-volt cable through the hole in cabinet.

In Model 52 the four nuts on the bolts holding the bottom of the power unit to the shelf of the cabinet are rather inaccessible unless the rear grill is removed. Or, if desired, one person may hold the nuts with a hexagon wrench while another turns the screws.

Testing

Apply the continuity tests given in the table on the following page. If the tests indicate that one of the resistances is defective, it may be replaced. If anything is defective in the power transformer chokes or condensers (which are all sealed as a unit in the metal container), remove the lid of unit, the panel assembly, the toggle switch, the cable, the regulating resistance, and the rectifier tube socket, substitute a new sealed container for the defective one and connect the panel assembly, switch, cable, regulating resistance and socket to the new sealed container exactly like the original.

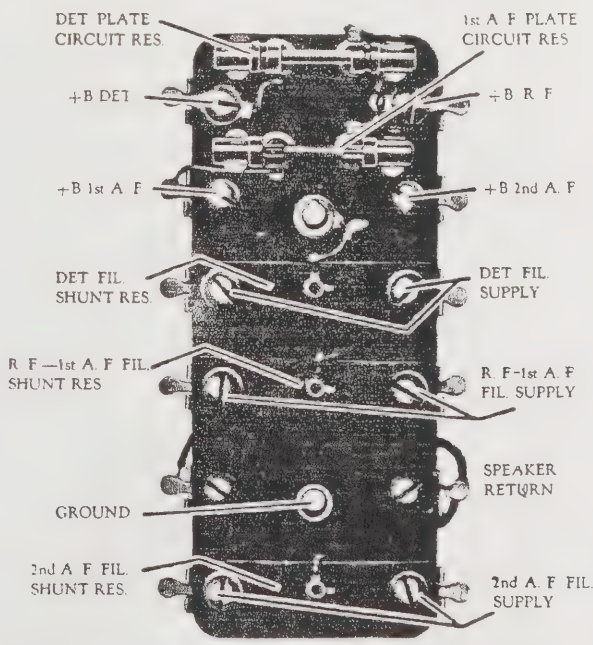


Fig. 76. Bottom View of Panel Assembly Used in Power Unit of Models 40, 42, 44 and 52

The terminal at the left of the ground eyelet (in this view) is used as a junction point for the lead from the centre-tap of the R.F. 1st A.F. filament shunt resistance, and the blue (red in some models) lead from the 1st A.F. by-pass condenser. This terminal is not connected to the set.

Continuity Test Table—Power Unit for Models 40, 42, 44 and 52

For Following Tests Remove Cable Connection Panel from Unit

TEST	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
Across 2nd A.F. Filament Supply.	*Full*	None—Open 2nd A.F. fil. winding and open 2nd A.F. filament shunt resistance.	Nearly full—open filament winding. (Unsolder one fil. winding connection and test winding and fil. shunt resistance separately.)
Across R.F.-1st A.F. Filament Supply.	*Full*	None—Open R.F.-1st A.F. fil. winding and open R.F.-1st A.F. fil. shunt res.	Nearly full—open filament winding. (Unsolder one fil. winding connection and test winding and fil. shunt resistance separately.)
Across Detector Filament Supply.	*Full*	None—Open det. fil. winding and open detector filament shunt resistance.	Nearly full—open filament winding. (Unsolder one fil. winding connection and test winding and fil. shunt resistance separately.)
FROM +B R.F. to			
+B 2nd A.F.	*Partial*	None—Open speaker (output) choke.	Full—Shorted speaker choke.
+B 1st A.F.	*Small*	None—Open 1st A.F. plate circuit res.	
+B Detector.	*Very Small*	None—Open detector plate circuit res.	
Ground.	*None*	Shorted filter condenser.	
F1 (on Rectifier Tube Socket.)	*Partial*	None—Open plate supply filter choke.	
FROM GROUND to			
+B Detector.	*None*	Shorted by-pass condenser.	
One Side of 2nd A.F. Filament Supply.	*Partial*	None—Open 2nd A.F. grid bias resistance.	Full—Shorted bias resistance.
One Side of R.F.-1st A.F. Filament Supply.	*Partial*	None—Open R.F.-1st A.F. grid bias resis.	Full—Shorted bias resistance.
One Side of Detector Filament Supply.	*Full*	Open connection to center-tap of detector filament shunt resistance.	Examine connections under panel assembly.
+B 1st A.F.	*None*	Shorted by-pass condenser.	
P1, P2 (on Rectifier Tube Socket.)	*Nearly Full*	None—Open high voltage sec. winding.	
Each Terminal of A.C. Plug.	*None*	Grounded primary of power transformer.	Inspect A.C. cable and switch leads for accidental grounds.
OTHER TESTS			
Across Terminals of A. C. Plug. (Toggle Switch "On.")	*Full*	Open primary of transformer or open cable or switch leads.	
F1 to F2 (on Rectifier Tube Socket.)	*Full*	Open rectifier filament winding or connections.	
One Side of 2nd A.F. Filament Supply to Speaker Return Terminal.	*Full*	Open connection to center-tap of 2nd A.F. filament shunt resistance.	

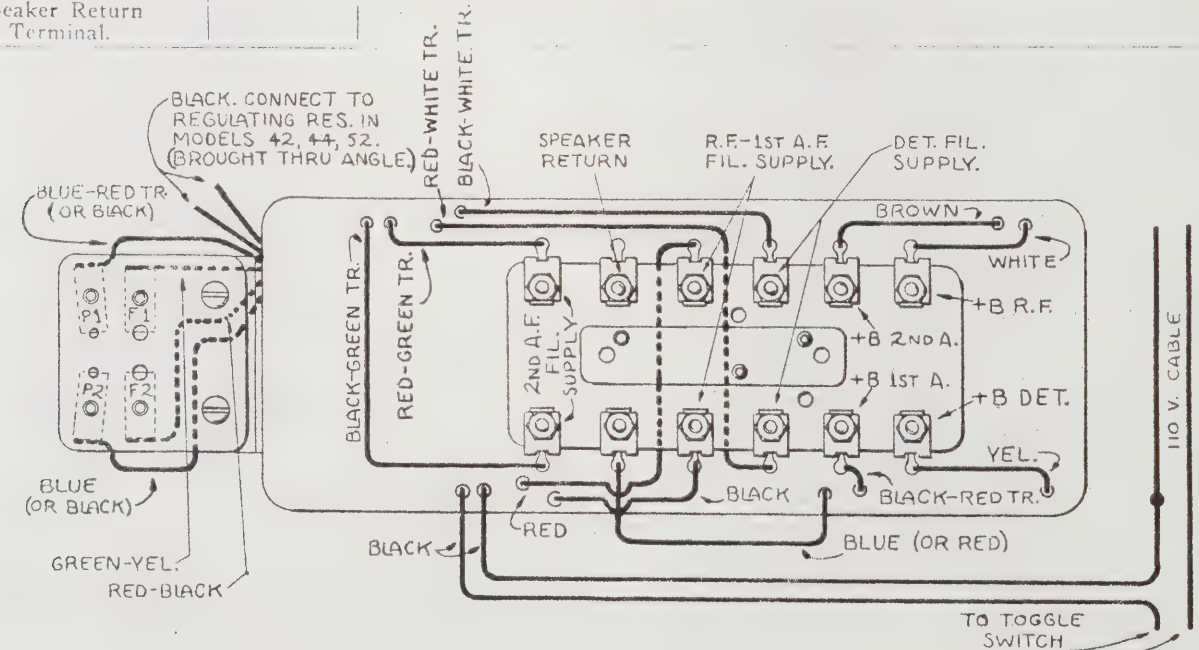


FIG. 77. POWER UNIT IN MODELS 40, 42, 44 AND 52, SHOWING CONNECTIONS FROM SEALED CONTAINER TO PANEL ASSEMBLY, RECTIFIER SOCKET AND REGULATING RESISTANCE

This view shows the approximate position of leads from sealed container. In Models 42, 44 and 52, a hole is cut in the rectifier-socket mounting angle and the two black leads are brought up through the hole and connect to the regulating resistance, which is mounted upright at the left hand end of the sealed container.

Voltage Test Chart

Atwater Kent A. C. Sets

(Measurements made while set is in operation)

FIL. VOLTAGES (Use 0-5 A. C. meter)	TEST TERMINALS (Colors of cable leads)	Model 36 Model 37 to Serial No. 1,265,000	Model 37, Serial No. 1,265,001 to 1,385,000	Model 37, Serial No. 1,385,001 and up	Model 38	Models 40, 42, 44 and 52	Model	Model	Model	Model
		APPROXIMATE VOLTAGE								
Detector	Red-white tr. to black-white tr.	2.3	2.2	2.3	2.3	2.35				
R. F. & 1st A. F.	Red to black	1.4	1.45	1.3	1.3	1.45				
Power (2nd A. F.)	Red-green tr. to black-green tr.	4.8	4.7	4.8	4.8	4.8				
PLATE VOLTAGES (Use high resistance D. C. meter)										
Detector	Red-white tr. to yellow.	30	25	30	48	44				
R. F.	Red to any R. F. tube "P" contact (thru eyelet).	135	165	170	180	160				
1st A. F.	Red to black—red tr.	110	135	160	160	155				
Power (2nd A. F.)	Red-green tr. to brown.	120	145	175	180	180				
BIAS VOLTAGES (Use high resistance D. C. meter)										
On Power tube	F to G (socket 2A, thru eyelets).	25	30	45	45	45				
On R. F. and 1st A. F. tubes	F to G (socket 1A, thru eyelets).	12	12	13	13	13				

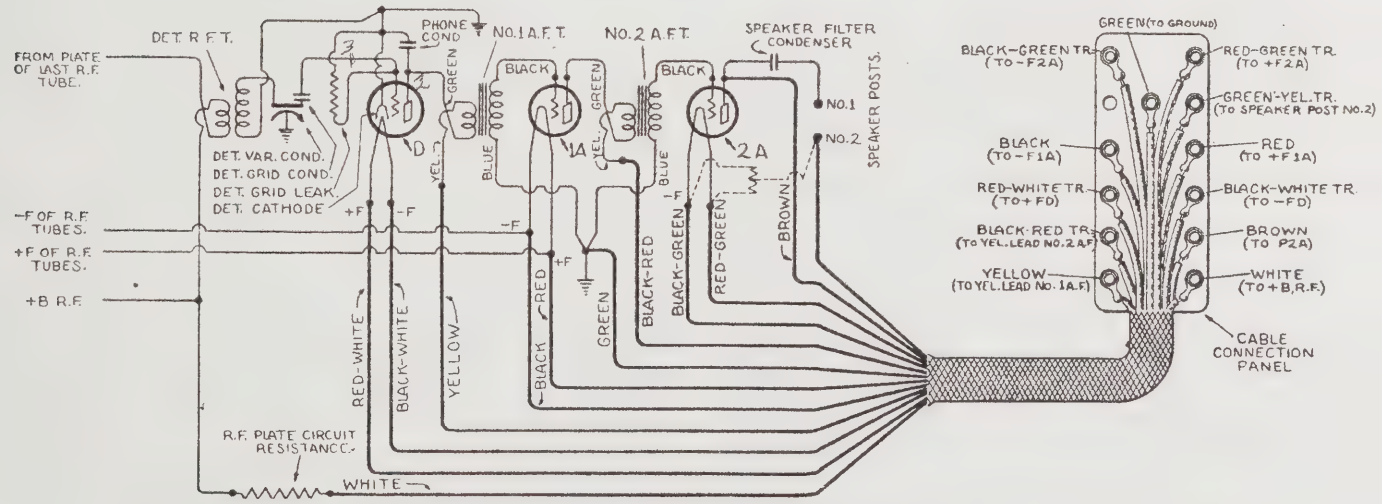


FIG. 78. DETECTOR AND TWO STAGE AUDIO FREQUENCY AMPLIFYING CIRCUIT USED IN LATER MODEL 36, AND IN MODELS 37, 38, 40, 42, 44 AND 52

The 2nd A. F. filament shunt resistance (shown in dotted lines) is used in all Model 36 sets and in many Models 37 and 38. In later Models 37 and 38, and in Models 40, 42, 44 and 52, this resistance is not used in the set, but the 2nd A. F. filament shunt resistance in the power unit is used for the same purpose, a green-yellow tracer lead connecting speaker post No. 2 to the centre tap of the 2nd A. F. filament shunt resistance in the power unit. In Model 36, and in Model 37 console sets, the two terminals on either side of the ground eyelet are used for toggle switch connection in the 110 volt line. In some Model 36 sets a green-yellow tracer lead is used instead of a black-red tracer lead for connection to the yellow lead of the 2nd A. F. T. The R. F. plate circuit resistance is not used in Model 36 nor in some 37 and 38 sets. Except for these minor variations, this circuit is standard in these sets, and the service man should remember the color scheme of A. F. transformers and the colors of cable leads and their location on the connection panel.

SERVICING THE "B" POWER UNIT

1. General Description

This unit is designed to replace the usual dry or wet "B" batteries as a source of plate current supply, taking its power from the 110-volt, A.C. house-lighting system and converting it into direct current of sufficient voltage for the plate requirements of a standard set. The operation of this device is, briefly, as follows:

The first step in transforming the A.C. to D.C. at required voltages, is to raise or "step up" the 110 volts to the necessary value for plate supply, taking into consideration the losses to be encountered in the later necessary processes of rectifying and filtering the current. This step-up is accomplished by the use of a transformer, which is designed so as to deliver about 500 volts at the secondary terminals.

The next step is the changing of the higher voltage alternating current delivered by the transformer to a current in one direction, and this is done by means of a special design tube known as a rectifying tube. This changes the A.C. into pulsating direct current, current in one direction, rising and falling between zero and maximum.

The rectification effect produced by the tube in the "B" Power Unit is somewhat the same as that produced by the detector tube of the radio set; however, the construction of the tube is quite different. No filament is used, there being, however, three electrodes, two of these being single, straight vertical wires and the third a double cylindrical grid of fine wire surrounding the other two. The form of the grid resembles on a small scale that of the double coil used as the R. F transformer on some of our receivers. A rare metal is used in the construction of both the straight electrodes and the grid. The tube is filled with a specially purified rare gas under reduced pressure. (See Fig. 79.)

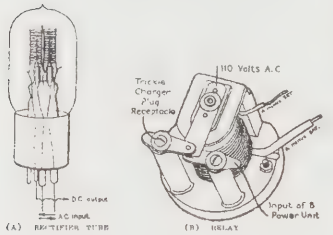


FIG. 79. TWO ELEMENTS OF "B" POWER UNIT.

Due to peculiar properties of the internal elements making up the tube, the gas will conduct current freely when flowing from either of the straight electrodes to the grid, but it acts practically as an insulator for a current in the opposite direction.

The two straight electrodes are connected to the secondary terminals of the step-up transformer, while a wire connected to the cylindrical grid leads to the "load" (filters, resistances and B circuit of the set), the return wire from the load running to a center tap on the transformer secondary. Connection is obtained to the three elements of the tube by having it fitted with a standard UX type base, one of the four prongs being unused. A better understanding of the circuit described above will be had by referring to the schematic diagram furnished in this section (Figs. 80 and 82).

The pulsating direct current delivered by the rectifying tube is not suitable for plate supply, so it is necessary to "filter" or smooth out this current to give an even flow. This is done by means of a special arrangement of choke-coils and condensers, the connection layout and values of these individual parts having been determined after extended laboratory experiments. (See illustration Fig. 82.)

We now have an even flow of direct current and all that remains to be done is to distribute this current to the various plate circuits of the radio set at the proper values for maximum performance. A set of resistances and by-pass condensers is used to accomplish this. Binding posts are provided on the panel of the "B" Power Unit properly marked for connection to the correct cable terminals of the set.

The Atwater Kent "B" Power Unit includes a plug receptacle for connecting a trickle charger to use in keeping the A storage battery charged. The plug from the trickle charger is placed in this receptacle and by means of a "relay" incorporated in the "B" Power Unit, the 110-volt current which is supplied to the "B" Power Unit is automatically transferred to the trickle charger when the radio set is turned off by the switch button on the panel.

The relay is in effect an automatic single-pole double-throw switch directly controlled by the filament switch on the radio set. It consists of a coil of wire with a soft iron core, an armature being supported over the core and carrying a contact spring which is insulated from it (the armature). Two other contact points are mounted, one above and one below the contact spring so as to make and break with the two corresponding points on the spring itself when the relay operates. (See Fig. 79.)

The magnet coil is connected in series with the "A" battery or filament circuit of the set. The contact spring is connected (thru the plug of the "B" Power Unit) with one side of the 110-volt, A.C. supply. The

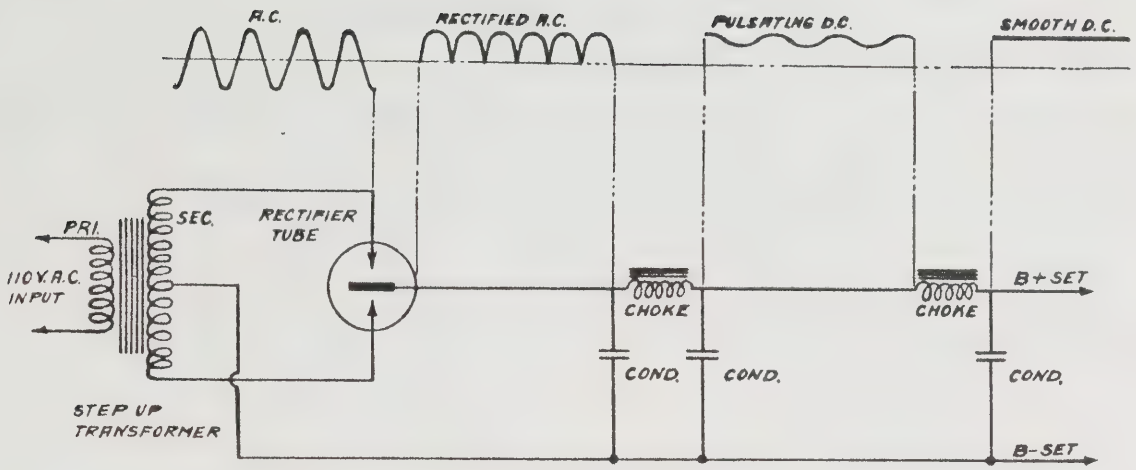


FIG. 80. STEPS IN PROCESS OF RECTIFICATION OF CURRENT BY "B"-POWER UNIT.

upper contact point is connected to one terminal of the trickle charger receptacle and the lower to one side of the input of the "B" Power Unit. The two remaining terminals—one of the trickle charger receptacle and the other of the "B" Unit input—are permanently connected to the other side of the 110-volt, A.C. line. The operation is as follows:

When the radio set is turned on, the coil is magnetized by the "A" battery current passing thru it, causing the armature (carrying contact spring) to be drawn down to make contact with the lower point, thereby closing input circuit to "B" power unit. When the set is turned off, the armature is automatically released by the coil losing its magnetism. The contact spring then touches the upper contact point, sending the 110-volt current thru the trickle charger, which has been connected in the circuit by placing its plug in the receptacle at front of "B" Power Unit.

2. Determining if "B" Power Unit is at Fault

When radio reception is unsatisfactory, and it is felt that the "B" Power Unit may be at fault, it is advisable to first check up on the other accessories used, testing the tubes, A and C batteries, checking connections at A battery terminals, and examining aerial, ground and speaker.

If these accessories all test O. K., it would then be a good plan to temporarily substitute a good set of 45 volt dry B batteries for the "B" Power Unit, which will readily indicate whether the latter has been functioning normally. If this test shows that the "B" Unit may be "dead," a new rectifier tube should first be tried out, as occasionally some trouble may develop in this part. The replacement of the tube will of course correct this, and the defective one should be returned to the distributor.

3. Measuring Voltage of "B" Unit

Another way of determining if the "B" unit is defective is to measure the output voltage while the unit is connected to a receiving set in operation. Measurement should be made with a high resistance D. C. voltmeter. The following approximate voltages should be obtained on a line voltage of 110-115 A. C., assuming a standard six tube set is being used, with a power tube in the last audio socket.

Measure from B minus to	Approximate Voltage
B + PWR	135
B + AMP (Post No. 2 or 3)	70
B + DET	25

If the voltages are considerably different from the values given above, or if no voltage is obtained from B— to each of the B+ terminals, some part of the "B" unit is probably defective, and it will therefore be necessary to dis-assemble the unit.

4. Taking the Unit Apart

Remove the cover by taking out the four machine screws around sides, then remove the four "feet" by taking out screws in them and also remove the single screw from bottom of case. Next remove the screws which hold the bakelite binding post panel to the metal case and also the two which hold the receptacle for plug from trickle charger. The entire unit can then be lifted out of the case, after pushing the panel and plug receptacle inside so that they will not catch as the assembly is being lifted up and out.

5. Continuity Tests

Using the regular testing equipment, consisting of a 45 volt "B" battery and a 0-50 voltmeter, make the tests given in the accompanying test table.

If the test indicates that a section or block of the unit is defective, that section should be replaced and returned to the distributor.

6. Possible Troubles

Condition.	Cause
No reception	Shorted condenser, open choke coil, open primary of transformer.
Noisy reception (crackling)	Defective rectifier tube.
Intermittent reception. (When "B" unit is shaken)	Poor contact of tube in socket, half-broken lead or connection.
Sluggish starting of receiver to function	Defective rectifier tube, dirty or burned relay contacts.
Noticeable darkening of glass of rectifier tube	Defective tube.
Abnormal heating in "B" unit	Shorted turns in transformer.
Excessive hum	One side of secondary open.

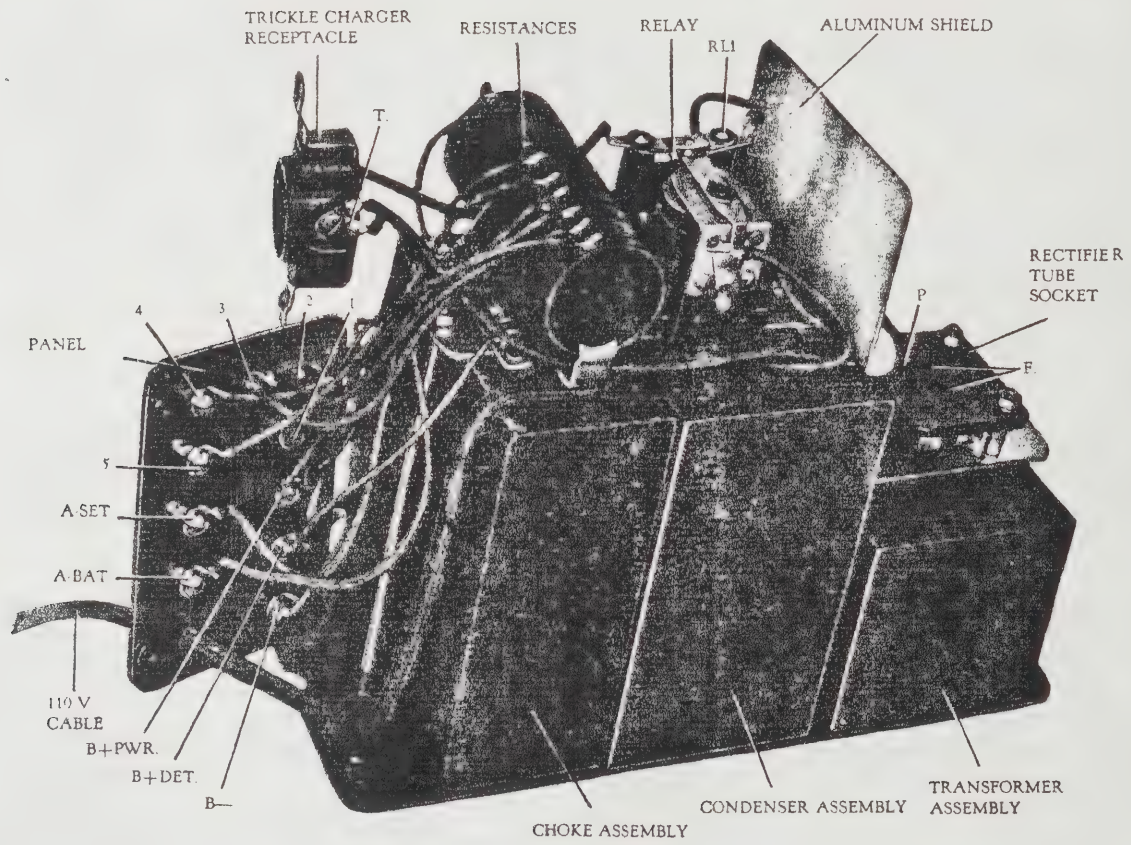


FIG. 81. VIEW OF "B" POWER UNIT.

Wiring Diagram and Test Table for "B" Power Unit

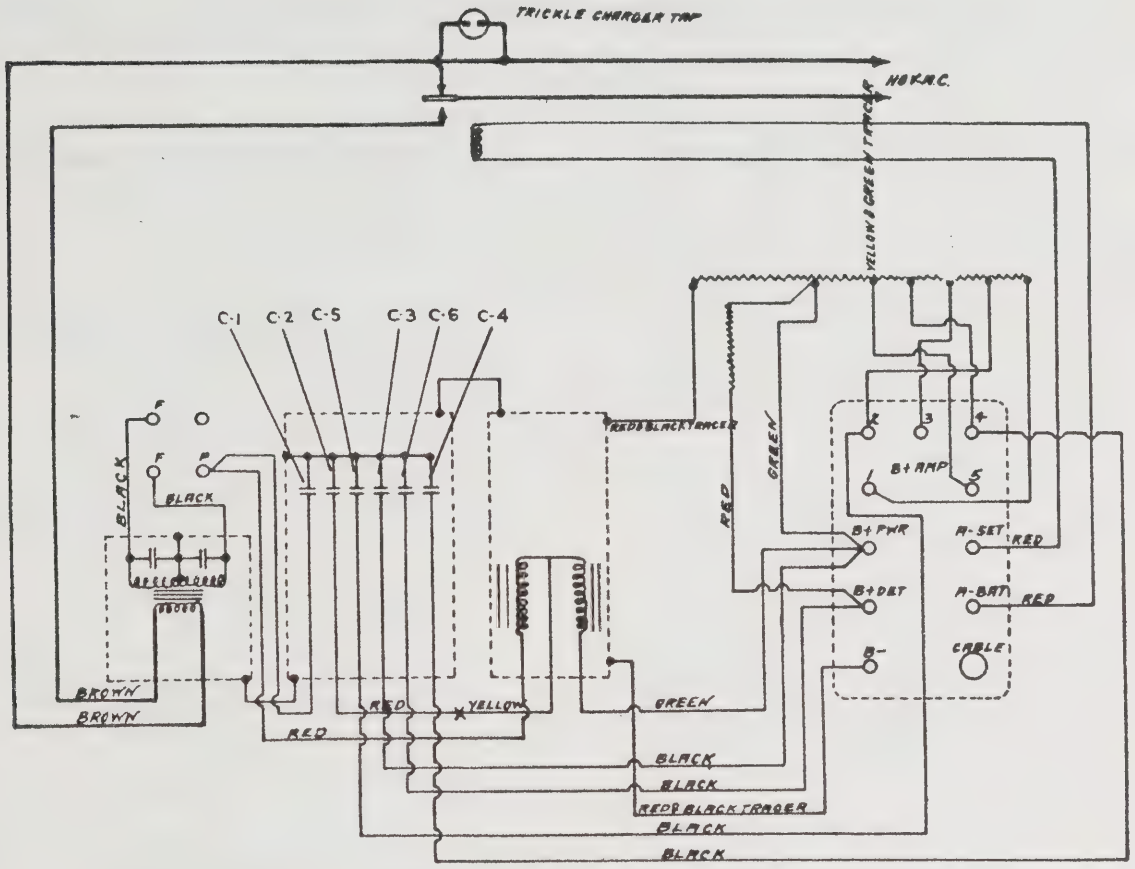


FIG. 82. B-POWER UNIT. MODEL R No. 8800 (Wiring Diagram).

NOTE.—In Model "S" Unit for 25-cycle A. C. Power, Condenser C-5 is Connected to Post 3 of "B plus AMP," and Condenser C-4 is Omitted.

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
B— to Exposed Portion of Three Metal Containers.	*Full*	Open ground connection.	See that ground straps are soldered together.
B+ PWR.	*Partial*	None—Open regulating resistance.	Full—Shorted filter condenser or grounded choke.
B+ AMP. (Taps Nos. 1, 2, 3, 4, 5).	*Partial*	None—Open resistance.	Reading should increase slightly from 1 to 5.
B+ DET.	*Small*	None—Open detector plate circuit resistance.	Full Reading—Shorted by-pass condenser.
A— BAT.	*None*	Grounded relay coil circuit.	
Both Terminals of A.C. Plug.	*None*	Grounded primary circuit of power trans.	
Each of Two Large Holes on Rectifier Socket.	*Nearly Full*	Open connection sec. of power transformer.	
OTHER TESTS			
RL1 to Point "T" on Trickle Charger Receptacle.	*Full*	Open primary of power transformer.	**NOTE: In case any one of the filter or by-pass condensers is thought to be defective, its connecting lead should be unsoldered from the rest of the circuit and the condenser tested separately for possible short circuit. The filter chokes may be tested in the same manner.**
Across Two Large Holes on Rectifier Tube Socket.	*Nearly Full*	None—Open secondary of power trans.	
B+ PWR. to Contact "P" (on Rectifier Tube Socket.)	*Partial*	None—Open filter choke coil.	
A— Set to A— Bat.	*Full*	Open relay coil circuit.	

Section VIII

CHART OF TROUBLES AND PROBABLE CAUSES

A—Battery Sets Only

1. Tubes fail to light	1. A battery discharged. 2. Badly corroded A battery terminal. 3. Burned out or open rheostat. 4. Broken filament lead in cable. 5. Defective filament switch. 6. Defective tubes.
2. Tubes light, no reception	1. B voltage supply dead or defective. 2. Open in B lead in cable. 3. Incorrect B connections. 4. A battery connections reversed. 5. Open primary of transformer (A. F. or R. F.). 6. Shorted grid condenser. 7. Open coil in speaker. 8. Defective tube. 9. Shorted by-pass condenser.
3. Disturbing noises (occurring with antenna and ground disconnected)	1. Run-down or defective B battery. 2. Defective B power unit. 3. Poor connection at A battery terminal. 4. Loose connection to B supply. 5. Defective phone condenser. 6. Defective audio transformer. 7. Defective speaker cord. 8. Defective by-pass condenser.
4. Distorted tone	1. Interference (two stations on same frequency). 2. Batteries exhausted. 3. Speaker out of adjustment. 4. Incorrect C voltage. 5. C battery disconnected. 6. B power unit incorrectly connected or adjusted.
5. Intermittent reception	1. "Fading" due to atmospheric conditions. 2. Antenna or lead-in touching grounded object. 3. Loose or corroded connection in fil. circuit. 4. Defective grid leak. 5. Loose connection in set or cable. 6. Local receiving set interfering.
6. Continuous whistle or hum	1. Microphonic tube. 2. Speaker too close to set. 3. Defective B power unit. 4. Low Detector B voltage. 5. Heterodyne. 6. Open grid circuit (detector). 7. Grounded A. F. transformer. 8. Open antenna choke.
7. Reception weak	1. Defective tube. 2. A or B voltage low. 3. Poor location. 4. Defective battery connections. 5. Weak audio transformer. 6. Grid resistance open. 7. Secondary R. F. transformer open. 8. Condensers poorly synchronized. 9. Defective grid leak.

B—A. C. Sets Only

1. All tubes fail to light	1. Line voltage D. C. instead of A. C. 2. Open primary power transformer. 3. Open lead in A. C. plug cord.
2. One or several tubes fail to light	1. Defective tube. 2. Open secondary of power trans. low voltage. 3. Open wire to filament circuit.
3. Tubes light, no reception	1. Defective rectifier (or other) tube. 2. Open secondary power trans. (high voltage). 3. Shorted condenser in power unit. 4. Open choke in power unit. 5. Open plate voltage resistor. 6. Shorted speaker choke. 7. Defective audio. trans. (open primary).
4. Reception weak	1. Shorted primary transformer. 2. Shorted secondary power transformer. 3. Defective rectifier tube. 4. Same causes as under battery sets except first four.
5. Distorted tone	1. Shorted primary power transformer. 2. Shorted secondary power transformer high or low voltage. 3. Defective rectifier tube. 4. Open biasing resistance. 5. Speaker out of adjustment. 6. Shorted biasing resistance.
6. Intermittent reception	1. Defective rectifier tube (loose filament). 2. Open biasing resistance. 3. Loose connection in power unit. 4. Same reasons as under battery sets.
7. Continuous hum	1. Secondary power transformer open (one side, high voltage). 2. Open ground on secondary. 3. Shorted filter choke (power unit). 4. Open filament shunting resistance. 5. Same causes as under battery sets (except No. 3).
8. Overheating	1. Shorted primary power transformer. 2. Shorted secondary winding or circuit.
9. Disturbing noises	1. Induction thru A. C. power lines. 2. Loose connection in power unit. 3. Causes 5-6-7 under battery sets (A, 3).

C—Both, A. C. and Battery Sets

1. Oscillation	1. Defective ground connection. 2. Unsuitable R. F. tubes. 3. Grid resistance shorted. 4. Excessive R. F. plate voltage. 5. Open secondary R. F. transformer. 6. R. F. by-pass poorly grounded. 7. Antenna lead too close to set (wood cabinet sets).

SECTION IX
TROUBLES MOST FREQUENTLY ENCOUNTERED

A. In Either Type Set (Battery or A.C.)

CONDITION	CAUSE	SYMPTOMS	REMEDY
1. Grid resistance burned out.	Shorted tube.	Reception weak.	Replace resistance unit.
2. Audio Trans. primary open.	Electrolysis.	Reception dead.	Replace transformer.
3. Audio Trans. secondary open.	"	Distorted reception.	" "
4. Antenna choke burned out.	Shorted tube, No. 1 socket.	Reception weak; hum.	Replace antenna choke.
5. R. F. T. primary burned out.	Shorted tube.	Set dead or very weak.	Replace R. F. transformer assembly.
6. Condenser dial out of adjustment.	Dial slipped on shaft.	Incorrect dial setting.	Loosen set screw in dial knob and reset correctly—pointer at 100, with plates fully enmeshed.
7. Condenser rotor assembly out of adjustment (3-dial sets).	Rotor assembly loosened thru jarring.	Irregular dial settings.	Loosen set screws at ends of rotor tension spring and reset assembly so rotor plates are equally spaced from stationary.
8. Condenser pulley belts loose or broken.	Forcing of tuning dial.	Tuning dial does not control condensers.	Replace belt, removing set chassis from cabinet and condenser panel assembly from main panel to make belts accessible. (See Secs. VI and XI.)
9. Condensers out of synchronism.	Rough handling or jarring of set.	Lack of volume and selectivity.	Resynchronize condensers. (See Sec. XI.)
10. Leaky by-pass condenser.	Excessive "B" voltage or excessive humidity.	Weak reception, rapid "B" battery consumption, set fails to operate on "B" eliminator (battery sets).	Replace by-pass condensers. Use No. 8685 for replacement on all battery sets, except No. 4640 and No. 4880.
11. Shorted phone condenser.	Defect.	Noisy reception.	Replace phone condenser.
12. Open wire in power cable.	Indefinite.	Set dead or tubes fail to light.	Repair break or replace cable.
13. Defective grid leak.	Defect.	Reception choked.	Replace leak.

B. In A.C. Sets Only

1. Volume control burned out.	Shorted tube.	Volume can't be reduced.	Replace resistance unit.
2. Volume control noisy.	Resist. wire spread unevenly or slider coated with oil or not pressing hard on resistance wire.	Volume knob does not turn smoothly or turns too smoothly.	Replace resistance unit or clean slider and resistance and bend slider to make better contact with wire. Use latest type of slider and resistance unit.
3. Power transformer pri. open.	Indefinite.	No voltage—set dead.	Replace transformer assembly.
4. Power transformer pri. shorted.	"	Overheating—set weak.	" " "
5. Power transformer sec. open (high voltage winding).	"	Reception weak —hum.	" " "
6. Power transformer sec. open (low voltage winding).	"	One or more tubes fail to light.	" " "
7. Shorted condenser (power unit).	"	No reception.	Replace condenser-choke assembly (on Models 36, 37, 38).
8. Open choke (power unit).	"	No reception.	Replace condenser-choke assembly (on Models 36, 37, 38).
9. Open "B" voltage resistance (detector or No. 1 A. F.).	"	Reception very weak or none at all.	Replace resistance unit (tubular, under small panel top of power unit).
10. Open biasing resistance (226 or 171).	"	Distortion and blocking—hum.	Replace biasing resistance.
11. Defective rectifier tube.	"	Weak, irregular or distorted reception.	Replace tube.
12. Loose power transformer laminations.	"	Hum audible to ear.	Replace transformer (Models 36, 37, 38).

Note—A defect in the transformer, condensers or chokes, in the case of A. C. sets having a single sealed power unit container, will necessitate replacement of the sealed container.

SECTION X

SERVICING ATWATER KENT SPEAKERS

General Description

1. Horn Type

The sound unit of the Atwater Kent horn type speaker consists of a powerful permanent magnet similar to a horseshoe magnet, mounted at the end of a short cylindrical metal chamber. The two poles of the magnet have extension pieces, each of these being wound with a coil of very fine wire. These two coils are connected in series and also thru the speaker cable and plate circuit of the last tube of the radio set.

A diaphragm in the form of a circular disc of special alloy metal, carefully mounted between rubber gaskets, is suspended so that its surface rests but a small fraction of an inch above the extension pole pieces of the magnet.

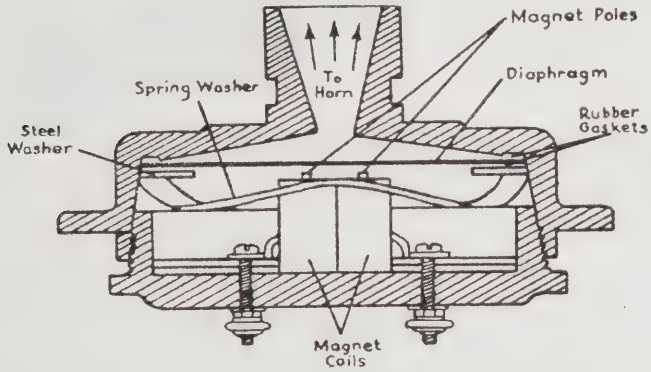


FIG. 83. CROSS SECTION VIEW OF SOUND UNIT (HORN TYPE).

The action of the unit is as follows:—When a radio signal enters the receiving set, as explained under Section I "Theory of Radio Receivers," it causes fluctuations or changes in the flow of current in the plate circuit. Since the magnet coils of the speaker unit are in series with the plate circuit, these changes in current will pass thru these coils, and this in turn will cause variations in the pull of the permanent magnet on the diaphragm. Accordingly the diaphragm vibrates, and in doing so, causes sound vibrations which pass thru the air column of the horn into the room to the listeners' ears, an almost perfect reproduction of the sound at the microphone of the broadcast station.

2. Cone Type (Models "E" and "E-2")

The Models "E" and "E-2" Speakers are of the "free-edge" cone type, and differ in many respects from other cone speakers on the market.

The magnet is a powerful double one, and the vibrating element a thin rectangular reed of special alloy steel, mounted so that one end can vibrate freely between two of the four poles of the magnet. A single magnet coil is mounted so as to surround and enclose the reed without touching it, and the current in the plate circuit of the radio set passes thru this coil.

The apex of the cone is attached directly to the reed by a novel spring mounting which supports the weight of the cone, but at the same time allows it complete freedom of motion.

As in the case of the horn-type speaker, the changes in the current from the set passing thru the coil of the speaker unit cause changes in the pull of the magnet on the reed, thus causing the reed and the cone attached to it to vibrate correspondingly. The cone vibrates the air directly, giving very lifelike reproduction.

Comparison Test

When an Atwater Kent speaker seems to be functioning imperfectly, it should first be tried out on reception in comparison with a speaker of similar type that is known to be good. If this comparison definitely indicates that the speaker is defective, it should be inspected and tested to determine the source of trouble.

Damaged Coil or Cord

If the speaker does not work at all, the trouble may be in an open magnet coil or an open cord. These may be tested with a voltmeter and battery. If the cord or the coil circuit is open, no reading will be secured on the meter. If the cord is damaged, or the connections half-broken, the meter will usually give an erratic reading when the cord is shaken.

In testing the coil, the voltmeter test points should be applied directly to the coil terminals on the sound unit. If the coil is open, the sound unit should be replaced. If the cord has an open lead it may sometimes be repaired satisfactorily, otherwise it should be replaced.

Detailed Service Information

1. Horn Type (including phonograph attachments)

A. Disassembling Horn Unit.

Remove gooseneck and horn from base of speaker, invert base and unscrew knurled cap all the way. Lift

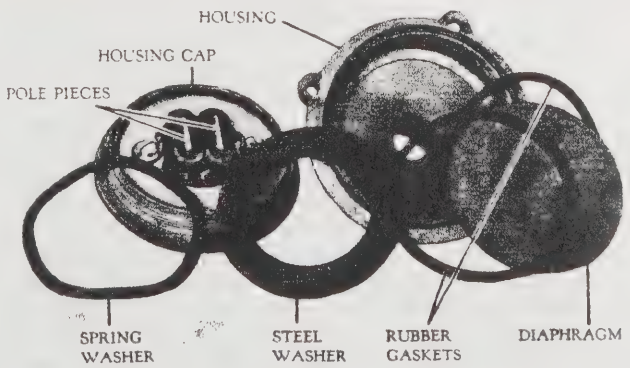


FIG. 84. HORN TYPE UNIT, DISASSEMBLED.

out the bronze retaining spring, then the steel washer and the rubber gasket, then the diaphragm and second rubber gasket at bottom. These parts are indicated in Fig. 84.

B. Testing.

Test the coil and cord for continuity and then carefully inspect the other parts, looking for the following.

C. Possible Troubles.

1—Iron or other foreign particles on pole pieces. (Sometimes these particles are so small as to be hardly visible).
Remedy:—Pick off with a small sharp knife, working outward and upward from between the pole pieces.

2—Diaphragm bent, buckled or up-side down.
Remedy:—Replace diaphragm or assemble correctly.

3—Weak spring. Spring may give insufficient pressure against diaphragm, causing rattling on very loud signals.
Remedy:—Replace spring or bend so as to increase height of all four of the bends, making them all exactly the same height.

4—Rubber gaskets. If these show signs of deterioration they should be replaced. If new gaskets are used in reassembling the unit, each should be stretched to fit tightly in the housing. This may be done by holding the gasket by both forefingers and expanding it for a moment to a length of about eighteen inches, repeating this three or four times.

5—Weak magnet. Test with weight-scale in the following manner:

D. Testing Magnets in Horn Type Units.

Equipment for testing the strength of the sound unit magnet is very simple and inexpensive, consisting of a small spring-type weight scale, about 0-10 pounds,—(which may also be used in testing the cone type sound unit magnets) and a circular flat disc, ground absolutely flat, of soft iron (Swedish or "Armco" iron) about 1 inch in diameter and 1/16 inch thick. This disc should have a small central stud, carrying a hole, attached to the center of one of its sides. A loop of strong flexible string, about an inch or two in length, should be attached to the hole in the stud.

To test the strength of the magnet in a horn type sound unit, place the flat side of the disc centrally on the pole pieces, loop the string over the weight-scale hook and carefully exert a steady pull exactly along the axis of the unit until the magnet lets go. The position of the speaker and scale is shown clearly in the accompanying illustration, Fig. 85.

When pulling on the horn type sound unit, the disc "armature" should not be released until the scale registers a pull of about 4 pounds or more. Assuming that the weight-scale has been checked for accuracy, if the reading is appreciably less than 4 pounds, and if the speaker is noticeably weak in actual reception, the sound unit should be replaced.

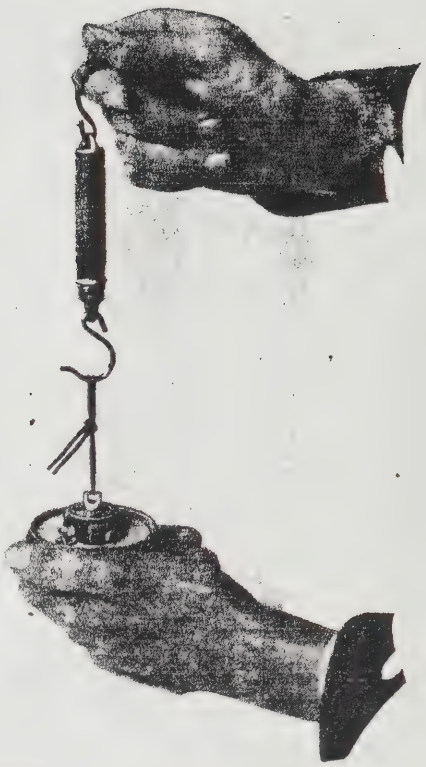


Fig. 85. Testing Magnet Strength, Horn Type Unit.

With time and use there is some unavoidable loss of magnetism in speaker magnets. But in general this decrease does not appreciably affect the performance of the speaker, so in all cases the final test should be in listening to actual reception. The magnetic strength tests are chiefly of value in eliminating one possible source of trouble.

After the unit has been carefully examined and tested, and any defective parts repaired or replaced, it may then be reassembled.

E. Assembling Horn Type Unit.

(1) RUBBER GASKET—place in its groove in housing and use the steel washer to press the gasket into place. The gasket should not fall out when the housing is inverted and shaken. The steel washer should, of course, be removed.

(2) DIAPHRAGM—center on the rubber gasket with the concaved side toward the horn. It is very important that the diaphragm should be placed with the concaved or hollow side facing the horn opening. Instructions to this effect are rubber-stamped on the concaved side of each diaphragm. Also it is extremely important that the diaphragm should be centered perfectly on the rubber gasket and that it does not touch the metal housing at any point, otherwise the diaphragm will rattle.

(3) RUBBER GASKET—place over the diaphragm and press into position with the steel washer, taking care not to disturb the diaphragm setting.

(4) STEEL WASHER—place over the rubber gasket with the concaved or hollow side facing the diaphragm. The concaved side of the steel washer may be found by laying a straight edge across the face of the washer and holding both up to the light.

(5) BRONZE SPRING WASHER—place in housing over the steel washer.

(6) HOUSING CAP—screw clockwise on housing.

F. Adjusting the Horn Speaker.

The speaker should be adjusted during reception of a strong and clear broadcast station. Screw up the knurled housing cap clockwise until the diaphragm snaps against the pole pieces, causing reception to become weak and rattling. It should then be unscrewed until a click occurs and reception comes out clear and normal, the best adjustment being as close (turned clockwise) as possible without rattling on a strong signal

It is necessary to have the horn type speaker leads connected to the receiving set in the proper manner, which is clearly specified on the Atwater Kent horn type sound units and also on the Atwater Kent battery-type radio receivers.

2. Free Edge Cone Type (Models E and E-2)

The Atwater Kent Model E and Model E-2 Speakers are of the free edge cone type. Their construction is much more rugged than that of the average cone, so that repairs are seldom required. All steel parts are thoroughly rust-proofed, and both the coil windings and the cone itself are impregnated with moisture-proofing compound.

The sound unit used in these speakers as now manufactured, is enclosed in a dust-proof rubberized bag which protects the unit from iron particles and dust.

In order to examine and test the parts, it is necessary to disassemble the speaker. Instructions for doing this and instructions for testing, repairing and assembling this type of speaker are given below.

A. Disassembling the "Type E" Speaker.

(1) Removing Grill.

Remove the four screws around the outer housing of speaker, then remove the front (grill) in this way:

Stand the speaker on a firm table, place a double fold of heavy cloth over the top of the grill of the housing, hook the thumb of the left hand under the top edge of the grill, with the other fingers of the left hand pressing down on the top of the housing, and then, through the cloth, hit the top of the edge of the grill several sharp blows with a hammer, at the same time pulling forward with the thumb. The vibrational effect of the hammer blows tends to loosen the grill from the housing, while the steady pull with the thumb tends to move the grill forward and off the housing. The cloth is used to protect the finish of the grill, which would otherwise be marred by the hammer blows. In removing the grill, be careful not to let it hit against the cone.

(2) Removing Cone.

The cone is attached to the flat reed spring by a small bolt and nut. Two special wrenches (Part No. 9255) should be used in removing this bolt, the illustration, Fig. 86, showing how this should be done. Hold the cone by the small metal bracket at its apex and pull straight off from the reed spring.

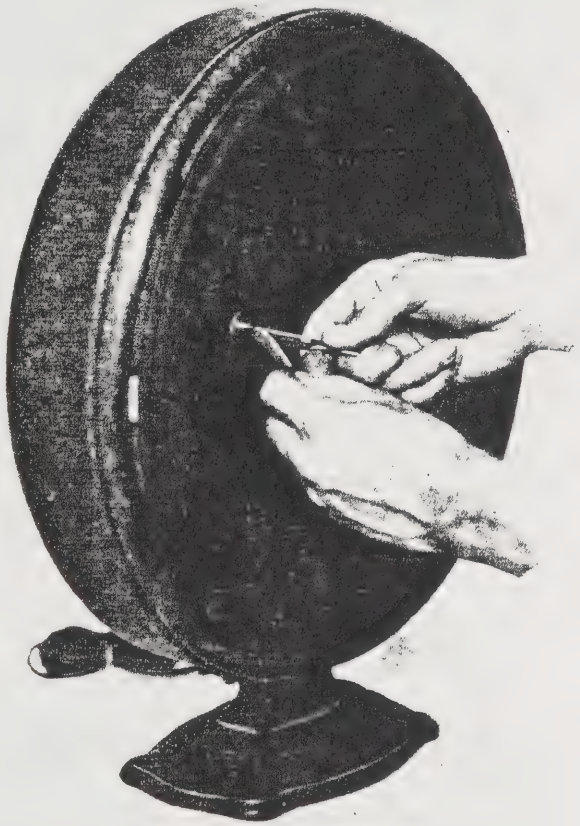


FIG. 86. REMOVING CONE, MODELS E AND E-2.

(3) Removing Sound Unit.

The sound unit is removed by unscrewing the two acorn nuts at the rear of the housing. Note how the cord is brought over the top and in back of the sound unit down to the small hole at the rear of the housing. When assembling the speaker, the cord should be arranged in the same way. In handling the sound unit be very careful not to strain the flat reed spring.

B. Possible Troubles.

1. OPEN COIL OR CORD—test with voltmeter and battery for continuity. Replace if found defective.

2. DAMAGED CONE—examine carefully for cracks and bends, especially around the apex. If no defect is found, hold the cone horizontally with hollow side up about 3 or 4 inches above a firm wood-topped table and then drop so that the apex will hit the table. If the cone is in satisfactory condition it will strike with a clear resonant "knock" rather than a dull, lifeless thump or thud. Replace cone if it seems to be defective.

3. METAL CHIPS ON POLE PIECES—carefully remove the dust-proof bag from the sound unit and examine the air-spaces between the reed and pole pieces to determine whether iron or other particles (caught up by the attraction of the magnets) are clogging up the air-spaces between reed and pole pieces and consequently interfering with free motion of the reed. If such a condition is found, it is sometimes possible to remove the particles, although usually it is advisable to replace the unit.

4. IMPERFECTLY ADJUSTED SOUND UNIT—examine the sound unit to see if the reed is adjusted centrally between the pole pieces so that the air-spaces at each side are equal. If the reed is not centered correctly, the unit should be replaced, although in exceptional cases a qualified service man may adjust the reed.

Adjustment of the reed is made through the two screws which pass through the magnet and bear on the reed. By loosening one screw and tightening the other, the reed may be moved to either side. When the reed has been adjusted exactly to the center the two screws should be tightened alternately little by little, until both are tight.

The adjustment may be tested by clasping the reed spring, near the reed, between the thumb and forefinger and pushing and pulling so as to cause reed to snap against either pole piece. The same force should be required to move the reed in each direction. If the unit is properly adjusted see that the air-spaces are free from chips and then carefully replace the dust-proof bag.

5. LOOSE NAME PLATE OR SERIAL PLATE—Suspend the grill by one hand and with the wood handle of a screw driver sharply tap the grill near the name plate. Listen carefully and if a "tinny" noise is heard, the name plate is not fastened securely and should be tightened by hammering down the holding tabs. Do the same with the serial plate on the back of the housing.

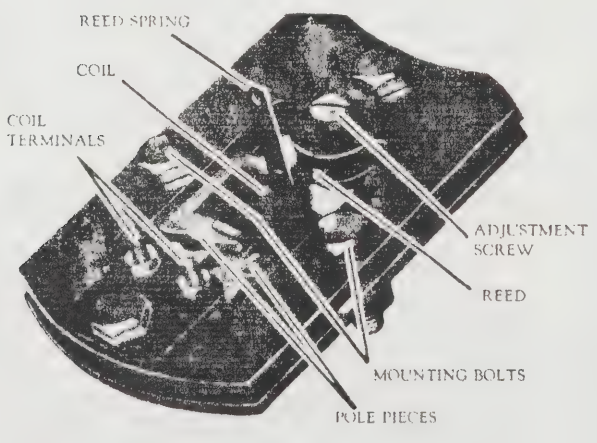


FIG. 87. CONE TYPE UNIT.

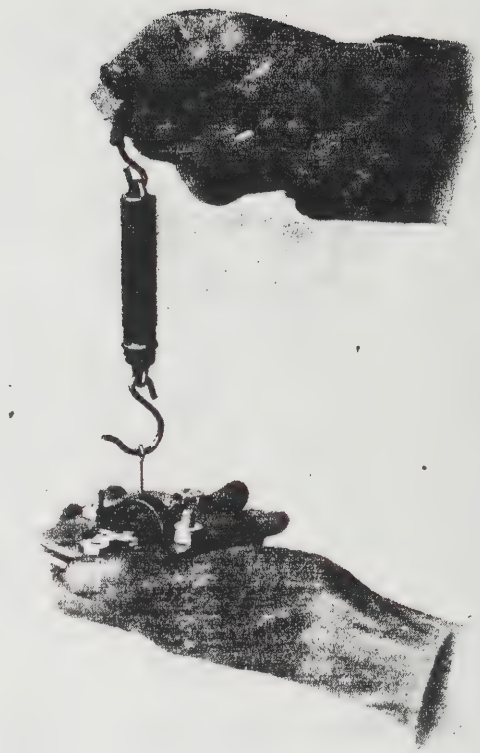


FIG. 88. TESTING MAGNET STRENGTH, CONE TYPE UNIT.

6. WEAK MAGNET—The testing outfit for determining the magnet strength is identical with that used for the horn speaker, except that instead of the flat disk a U-shaped bar is used. This bar must be accurately made so that when suspended, inverted, from the scale, its inside circumference clears the coil winding and the ends of the "U" rest flatly one on each magnet pole, lying clearly within the permanent magnet by about 1/64" on each side. It will be found more convenient to use the front or cone side of the unit for this test.

The dimensions of the bar are—width 3/8", thickness 3/32", diameter (over all) 1-3/16". If a straight pull of less than about 7 pounds will separate armature from magnet, a weak magnet is indicated and the unit should then be replaced. Fig. 88 illustrates the correct method of testing the magnet.

C. Assembling Cone Type Speaker.

1. ATTACHING SOUND UNIT—place the sound unit in the housing so that the mounting bolts pass through the holes in the back of the speaker, and screw on the acorn nuts. The unit should be enclosed in its dust-proof bag and the cord leads should be firmly attached to the coil terminals. The cord should be carried over the top of the unit, around the right-hand side and down to the outlet hole in the rear of the housing.

2. RUBBER DAMPER—push the small piece of rubber tubing on the flat reed spring, bringing it close to, but not touching, the unit.

3. MOUNTING CONE—push the metal bracket at the apex of the cone on to the flat reed spring and push the small screw thru holes. Screw on the nut but do not make it very tight.

With the two special wrenches (part No. 9255) on this small nut and bolt, tip the cone up or down so that its top and bottom edges are equally spaced from the housing, then carefully tighten the bolt. If the cone moves out of position, the bolt must be loosened and the cone again adjusted until the top and bottom edges are equally spaced from the housing when the bolt is fastened tightly.

Then examine the right- and left-hand edges of the cone to see if they are equally spaced from the housing. If they are not, use a pair of pliers to bend the reed spring very carefully and easily toward the side of the cone that is too close to the housing. When the spring is released it will be found that that edge of the cone is now spaced farther from the housing. Repeat this process until the right- and left-hand edges of the cone are equally spaced from the housing. The spacing between the edge of the cone and the housing should then be even all the way around. (In bending the reed spring, hold the pliers horizontally and grip the end of the metal bracket which fits over the reed spring. The best tool for this purpose is a parallel-jaw pliers, 3/8 inch wide, with the ends slotted to fit over the bolt and nut. The slot should be about 7/32 inch wide and 1/4 inch deep.)

4. REPLACING GRILL—Rest the speaker on its back and press the grill on to the housing, taking care to see that the screw holes coincide and that the grill is placed with the name plate right side up. It may be necessary to use a hammer in fitting the grill on the housing and, in this case, as before, a thick cloth should be used to protect the finish of the grill from the hammer blows. When the grill is in place, replace the four screws which hold it to frame.

3. Model E-3 Held-Edge Cone

The manner of disassembling, repairing and assembling the E-3 is exactly the same as for the E and E-2.

The cone of the Model E-3 speaker has a flexible rubberized fringe extending beyond the edge of the cone. Before the grill is placed on the housing, the cone and fringe are clear of the housing, with equal spacing all around between the rubber fringe and the housing. The grill has a strip of felt around its inside edge, and when the grill is pressed down on the housing, the outer edge of the rubber fringe is pressed tightly between the edge of the housing and the felt strip in the grill.

The small rubber damper is not used on the Model E-3 speaker.

Speaker in Model 52 Set

The speaker in Model 52 receiving set is of the "held-edge" type, somewhat like Model E-3. The flexible edge of the diaphragm is pressed all around between the housing flange and a large fibre ring.

To remove speaker, release cord tips from speaker posts on set, rest cabinet on its back, take out the six screws holding the speaker and draw out the speaker, fibre washer and grill.

An inspection of the speaker will then show that the diaphragm is mounted on the reed spring in the same way as in Models E, E-2 and E-3, with the exception that the edge of the diaphragm touches the metal flange all around.

Instructions for disassembling, testing, repairing, and re-assembling this speaker are similar to those given previously for the E, E-2 and E-3, with the following explanatory remarks:

(1) The small rubber reed-spring damper is not used on this model.

(2) In mounting the diaphragm, make certain that the edge of the cone (where it is joined to the flexible fringe) is level all around. If the diaphragm is not mounted properly on the reed spring, or if the spring is bent, the edge of the cone will extend up on one side and be depressed on the other. The remedy is the same as given above under the heading "Mounting Cone."

(3) The speaker is mounted in the cabinet with the outlet hole for speaker cord nearest the top, or set. The speaker cord is brought down and under the sound unit and up to the outlet hole.

(4) When replacing the speaker, put the fibre ring on top of the diaphragm, lining up the holes in the ring and those in the diaphragm and housing flange. Then place the wire grill on top of the fibre ring in such a way that, when mounted upright in normal position in cabinet, one set of equally-spaced grill wires will be horizontal and another set of equally-spaced wires will be vertical. (See paragraph immediately above.) Rest the cabinet of set on its back, and (for convenience of mounting) temporarily place a screw through the left hand hole in the housing flange, fibre ring and grill, with the head of screw toward the back of housing. Arrange the speaker in cabinet so this screw comes up through the left hand hole in front of cabinet and place a nut on this screw, meanwhile holding the speaker in place with one hand. Put in the other five screws (with the heads on outside of cabinet), remove the first screw and replace it properly.

Section XI

MISCELLANEOUS SERVICE INFORMATION

1. Use of Power Tubes in Battery Type Sets

The following battery sets were designed to permit the use of a power tube without change:

Model 20 Compact, No. 7960 (Serial Nos. 400,001 up).

Model 30 No. 8000 (later type).

Model 35.

Model 32.

Model 33.

Model 48.

Model 49.

Model 50.

Instructions are given below for changing the various earlier models of battery type sets so that a power tube can be used in the last audio socket:

Model 20 Compact, No. 7570 (Serial Nos. 200,000 to 395,766).

Model 30, No. 8000 (early type)

Remove chassis from cabinet and invert, exposing wiring under audio (3 tube) unit. Locate grid return wire leading from second audio transformer to blue wire of cable, and unsolder it from blue wire. Attach an additional short length (6 or 8 inches) of insulated wire to this lead from transformer, and bring this wire out through back of cabinet. This is the connection for the negative of "C" battery used for power tube. Connect positive of "C" battery to negative "A" battery terminal. Lastly, connect positive (black and red) terminal of speaker direct to highest voltage positive terminal of "B" batteries or "B" power unit, instead of to usual speaker post on set.

Note—If a 4½ volt "C" battery has been used already, it can be left connected, and it will then supply "C" voltage to the first audio tube only.

Model 20, No. 4640 (large cabinet), Model 19 and Model 24

Remove set from cabinet and invert. Locate grid return (red wire) which runs from second audio transformer to black wire leading from rheostat to post "Minus A." Unsolder this one red wire (there are two) from black lead, solder an 8-inch length of insulated wire to end of red wire, and bring this lead out for connection to negative of "C" battery. Connect positive of "C" battery to "Minus A" post of set. Apply 135 volts or required "B" voltage to power tube, by connecting positive speaker terminal direct to high voltage terminal of "B" batteries or other "B" voltage supply.

Open Type Sets (Mounted on Board)

Release cover from 3-tube unit and locate secondary wire from second (right-hand) audio transformer. This wire emerges from sealing compound in base of unit and is soldered to bolt head of post "Minus A." Remove this wire from this bolt, solder a separate length of insulated wire to it, and bring this lead out through ventilating hole in cover, to be connected to negative of "C" battery required by power tube. Connect positive of "C" battery to "Minus A" post of 3-tube unit.

Connect high voltage terminal of "B" batteries or "B" Power Unit, as described above for cabinet sets, direct to positive speaker cord terminal. Power tube is placed in last audio socket (right hand of two front tubes in 3-tube unit).

Note—Where dry batteries are used for "B" power, we suggest the "112A" type of power tube, 135 volts total "B" and about 9 volts "C" battery. Where storage "B" batteries or a good "B" power unit, such as the Atwater Kent Model "R," is used, we suggest using the "171A" type power tube. This tube gives perhaps a little better quality than the "112A" type, but consumes too much current to be economical when dry "B" batteries are used.

2. Replacement of Rheostat (Battery Type Sets)

(a) Removing Rheostat Assembly

(1) MODELS 20 AND 20 COMPACT. First unsolder wires leading from sub-panel to the Detector 2-stage amplifier assembly and the double rheostat. Remove the four screws which pass through the audio transformer bases which hold detector and audio panel to main sub-panel. This will release the assembly, making accessible the three screws which hold rheostat and switch panel assembly. Remove these three screws and rheostat can then be removed from main panel.

(b) Installing New Resistance

Pull out rheostat knob holding spring, releasing knob. Unsolder resistance wire terminal where it comes through panel, and pry out resistance unit. Insert new resistance unit, forcing down equally all around with suitable tool, pushing terminals through small holes in panel. Solder the one terminal, and bend the other over where it projects through panel a fraction of an inch. Replace rheostat knob, then knob holding spring and reassemble, reversing above procedure.

(2) MODELS 30 (early type) and 32. First unsolder the four wires leading to rheostat panel, remove station dial and vernier knob, take out the three screws underneath dial, which hold condenser assembly, then remove four screws (five on Model 32) on bottom of sub-panel. Next, pull condenser sub-panel assembly out from main panel, exposing three screws holding rheostat assembly

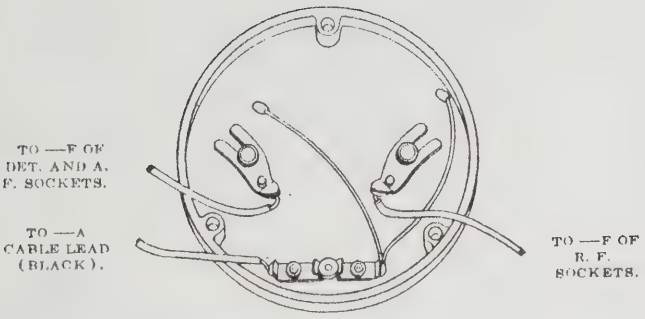


FIG. 89. REAR VIEW OF DOUBLE RHEOSTAT AND FILAMENT SWITCH ASSEMBLY USED IN MODELS 20 (No. 4640-7570), 19 AND 21.

to main panel. Pull rheostat off panel and repair as described under (1B). Reassemble set by reversing above procedure.

(3) Model 35. Remove tuning dial and lift set from cabinet. Then unsolder the three wires leading to rheostat and remove the two screws which hold it to panel. Rheostat can then be removed and repaired as necessary. (See paragraph 1B.)

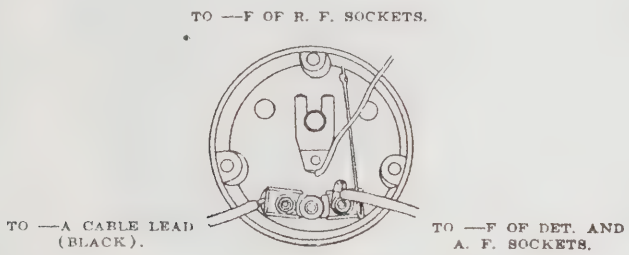


FIG. 90. REAR VIEW OF RHEOSTAT AND FILAMENT SWITCH ASSEMBLY USED IN MODEL 35.

(4) Models 30, 33, 48 and 49. Unsolder the four wires leading from rheostat panel to detector and audio assembly (where they are attached to latter). Remove station dial, vernier knob (also antenna adjustment knob on No. 33). Next remove the machine screws which hold condenser panel assembly to main panel (three at each end on Model 30, also one in center Model 33). Pull away sub-panel, exposing screws holding rheostat panel assembly, and then proceed as described under (1B).

(5) Model 50. Remove set from wood cabinet and metal case. (See Section VI.) Remove the six screws which hold front panel to condenser panel (3 at each

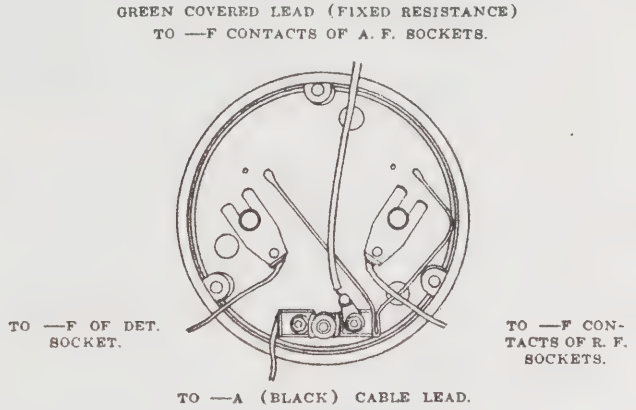


FIG. 91. REAR VIEW OF DOUBLE RHEOSTAT AND FILAMENT SWITCH ASSEMBLY USED IN MODELS 20 COMPACT (No. 7960), 30 (Early Type), 32, 33, 48, 49 AND 50.

NOTE.—The appearance of the rheostat in later Model 30 sets, and in Models 48 and 50, is slightly different from that shown above, but the connections are similar.

side). Let front panel drop forward, leaving rheostat panel attached to sub-panel. Remove the two screws which hold rheostat panel to sub-panel, releasing the former, so that it can be readily approached and repaired in the same manner as the other sets. (See paragraph 1B.)

3. Synchronizing Variable Condensers in One Dial Receivers

In order for a set of the single-dial type to be at maximum efficiency it is extremely important that all the variable condensers be "synchronized," that is, so adjusted on their shafts that they will all tune in a desired wave length with equal efficiency at any point on the wave band.

It is understood, of course, that all the R. F. transformers and condensers in any set are matched properly at the factory, and also are correctly synchronized, however, occasionally the synchronism is disturbed by a jar to the set in shipment, etc., in which case re-synchronizing is required. The apparatus required and procedure of checking is practically the same as described in Section III, under "Testing Set for Output," and is as follows:

For the purpose of checking a set which it is desired to synchronize, a pre-determined standard of volume of output should be made use of. This standard is obtained from a set known to be perfect, or better still, the average of the output of several sets of the same type, all known to be functioning properly. The volume must be checked on three wave lengths, at low, medium and high—as for example, at points 20, 40 and 80 on the dial. The procedure is as follows:

1—Place the signal-producing apparatus at such distance from the receiving test stand that when it is in operation with the dial set at 50, the output reading on the galvanometer of the test stand when connected to the standard set will be around 50 or 60. A little experimenting will be necessary to do this, but by regulating the position of the antenna wire from the transmitter, a satisfactory adjustment can be arrived at.

2—Turn on transmitter, loosen the set screws in condenser pulleys of the set being tested, and turn switch on test stand, so that the set being tested will register on the galvanometer. (Do not loosen screws in dial-condenser pulley.)

3—Set condenser dial of transmitter at 80 (high) and then turn the condenser rotor assemblies in the set by hand, until the signal is tuned in on the test stand, as shown by a maximum output reading on the galvanometer. Make a notation of the reading on paper. Great care should be taken that the position of antenna wire from transmitter is not changed during the following process, the setting of the tuning dial only being carefully changed when passing from one wave length to another.

4—Next set transmitter dial at 40 (medium) and readjust condensers in set for maximum galvanometer reading, again making a pencil notation of the reading.

5—Repeat this with the dial at 20 (low), again jotting down the reading obtained.

6—With condensers set for maximum volume at low, tighten set screws in pulleys very carefully so as not to disturb adjustment. The reading after they are tightened should be the same as when they were loose.

7—Now readjust transmitter to medium and high successively and note how the reading compares with the one obtained previously, when the belts were loose. If there is more than 25 or 30% lower output on either medium or high, it indicates that the radio frequency units are not matched and the set will not be up to standard on that particular band of waves, especially on distant reception. In such cases the trouble will most likely be found in either the R. F. transformer assembly or the variable condenser group. If a thorough visual inspection of the R. F. transformers does not reveal any defect, the condensers may be "out" and had best be replaced, as per instructions in Section VI.

8—The standard set should be connected to the test stand while the test is being made, so that by simply switching over to the standard set, the reading of the galvanometer on each wave length can be compared with the standard immediately. The standard set is used as a means of checking and keeping constant the output from the transmitter.

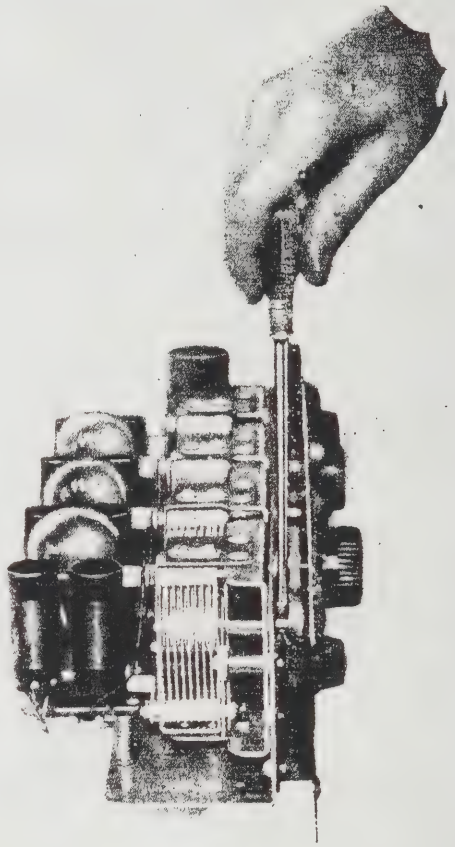


Fig. 92. Tightening Pulley Set Screws After Condensers Have Been Synchronized at a Low Wave Length.

4. Adjusting Tension of Belts in Single Dial Atwater Kent Receivers

On Atwater Kent single dial receiving sets the variable condenser to which the dial is attached (termed the "dial-condenser") is held in a fixed position by three screws.

Each of the other variable condensers is arranged in such a way that when its three screws are loosened, it may be moved independently a fraction of an inch toward or away from the dial-condenser, thus loosening or tightening one belt. When the condenser has been moved to the point giving the correct belt tension the three screws holding the condenser are carefully tightened.

At the factory the belt tension is determined by the use of an auxiliary gauge which gives an accurate indication of tension. These gauges are not available outside, so dealers' and distributors' service men must judge the tension by the "feel" of the belt when it is pressed down lightly with the forefinger. The belt must be tight enough to avoid "play" in the movement of the condenser, but the tension must not be great enough to bind the rotary plates.

The service man should carefully estimate the tension of belts on sets that have been adjusted at the factory, and then endeavor to secure the same tension on all belts that he may adjust.

In the case of sets in which the pulleys and belts are already properly arranged, the belt tension should be adjusted in accordance with the instructions given under the heading, **"Adjusting Belt Tension."** If the pulleys and belts have been removed from the set, as is neces-

sary when replacing the condenser assembly, they should be replaced as described under the separate headings "**Pulleys**" and "**Belts.**"

PULLEYS

Put dial-condenser pulley on the shaft of dial-condenser, with hollow side of the pulley facing set. This pulley has two short "pins" on its outside surface. Turn pulley so the **outer** one of the two pins is exactly on top. Hold pulley in this position and move rotary plates of the dial-condenser all the way inside the stationary plates. Then, with the pulley and condenser in this position, carefully tighten the two set-screws in the pulley. Make sure these screws are tight. The pulley should not be pushed in too far on the condenser shaft or the belt will rub against the set.

The illustrations (Figures 93, 94 and 95) show clearly how the other pulleys should be arranged on the condenser shafts.

The pulleys on the shafts of all variable condensers (except the dial-condenser pulley) must turn freely or difficulty will be experienced in synchronizing the condensers. Twirl each pulley to see if it moves freely. If it does not move easily, rub the condenser shaft and pulley-bearing free from dirt and try again. If the pulley sticks, replace it or smooth off the condenser shaft with a fine grade of emery cloth. Also remove any burrs from the ends of the pulley bearing.

Do not proceed further until the pulleys turn easily. If the difficulty is caused by a damaged condenser shaft, replace the group of condensers.

BELTS

(a) Each belt must be arranged with the eyelets (that clamp the two ends of the belt together) at the bottom of the belt loop. Each belt has two small holes, one to fit over one of the pins on the dial-condenser pulley and the other hole to fit over the pin on the pulley which that belt controls.

Loosen screws in the outer condensers and move them toward the dial-condenser so the belts will fit easily over the pulleys. In moving condensers, hold them by the heavy frame of the stator plates. Never place any strain on the pulley, shaft, or rotary plates of the condenser. .

(b) Models 30, 35, 37, 40, 41, 42, 48 and 50, Arranging Belts

First put on the belt that fits over the **inner** one of the two pins on the dial-condenser pulley and over the pulley of the third (right) condenser.

Then put on the belt that fits over the **outer** one of the two pins on the dial-condenser pulley and over the pulley of the first (left) condenser.

(c) Models 32, 33, 36 and 49, Arranging Belts

First put on the belt that fits over the **inner** one of the two pins on the dial-condenser pulley and over the third pulley.

Then put on the belt that fits over the **inner** one of the two pins on the dial-condenser pulley (it will be on top of the first belt) and over the pulley of the fourth (right) condenser.

Finally put on the belt that fits over the **outer** one of the two pins on the dial condenser pulley and over the pulley of the first (left) condenser.

(d) Models 38 and 44, Arranging Belts

First put on the belt that fits over the first (dial-condenser) and second pulleys, then the belt that fits over the first and third pulleys, and finally the belt that fits over the first and fourth pulleys. All three belts fit over the **inner** one of the two pins on the dial-condenser pulley.

ADJUSTING BELT TENSION

Preliminary Procedure

(a) See that the three screws holding dial-condenser to chassis are tight, and that the three screws in each of the other variable condensers are slightly loosened. Note that the holes through which these latter screws pass are slotted, allowing the condenser to be moved horizontally a fraction of an inch toward or away from the dial-condenser. Two pins projecting from the front of the condenser fit into two horizontal slots and serve to keep the condenser properly aligned. Be certain that the condenser pins are in the slots and not jammed outside. (Models 30 (early type) and 32 have moulded end-plate variable condensers and these do not have the projecting pins.)

(b) In Atwater Kent single-dial receivers having metal frame variable condensers, a hole is provided in the front of the chassis at the edge of each condenser. The hole is placed on that side of the condenser which is nearest to the dial-condenser. The frame of the condenser partly covers the hole. By inserting the blade of a screw driver (held in the left hand) in this hole and twisting the blade, the condenser may be moved away from the dial-condenser, thus tightening one belt. When the condenser is moved to the point giving the correct belt tension, keep the condenser in that position and then, with another screw driver in the right hand tighten the three screws that hold the condenser to the chassis.

In Models 30 (early type) and 32, both of which have moulded end-plate variable condensers, holes for moving the condensers are not provided in the metal bracket on which the condensers are mounted. In these sets the condensers may be moved with the fingers when adjusting the belts.

In four-condenser sets where two or three belts are placed over each other, the tension of the **under** belt must be adjusted first and the upper belts must be slack. If the upper belt is adjusted first, it will not be possible to judge the tension of the lower belt. The correct order for adjusting belts in the different sets is given below under separate headings for the various types of sets.

(c) The screws must be tightened carefully so the condenser will not move and change the belt tension. If the condenser does move, causing the belt tension to change, loosen the three screws, readjust the tension, and again tighten the screws. Repeat, if necessary, until when the screws are tight, the tension is correct. Make the screws very tight.

Models 30 (later type), 35, 37, 40, 41, 42, 48, 50 and 52, Adjusting Belt Tension

Adjust right-hand belt first. Insert the blade of a screw driver in the chassis hole at the left-hand edge of the third condenser. Twist the blade slowly, forcing the third condenser toward the right until the belt seems to have the correct tension, as judged by the finger, hold the condenser in that position and, with another screw driver, tighten the three screws. Adjust the left belt in the same general way. See paragraph (c) above.

Models 38 and 44, Adjusting Belt Tension

First adjust tension of belt that passes over pulleys of dial-condenser and second condenser. Then adjust belt passing over pulleys of dial-condenser and the third condenser, judging the tension by pressing down on this belt between the second and third pulleys. Finally adjust tension of belt passing over pulleys of dial-condenser and the right-hand condenser, judging the tension by pressing down on this belt between the third and fourth pulleys. See paragraph (c) above.

Models 32, 33, 36 and 49, Adjusting Belt Tension

First adjust belt passing over pulleys of dial-condenser and third condenser. Then adjust belt passing over pulleys of dial-condenser and fourth condenser, judging tension by pressing down on this belt between the third and fourth pulleys. Finally adjust left-hand belt. See paragraph (c) above.

Part Numbers of Pulleys and Belts

(Refer to Illustrations for Identification and Arrangement of Pulleys and Belts)

MODEL OF SET	BELTS			PULLEYS			
	"A"	"B"	"C"	No. 1	No. 2	No. 3	No. 4
30 (Molded end-plate variable condensers.)	7965	7965		9168	9169	9168	
35, 37, 48 and 30 (with metal frame variable condensers).	8146 (Long)	8136 (Short)		9168	9169	9168	
32	8146	8146	8282 (Long)	9168	9169	9168	9171
38	8963 (Short)	8964 (Long)	13264 (Extra Long)	9169	9168	9171 (Identified by two holes through side).	13263 (Identified by one hole through side and letter "E" stamped inside.)
50	8146	8146		9168	9169	9168	
33, 36 and 49	8963	8963	8964 (Long)	9168	9169	9168	9171
40-42-52	13484 (Long)	13483 (Short)		9168	9169	9168	
44	13675 (Short)	13676 (Long)	13677 (Extra Long)	9169	9168	9171	13263

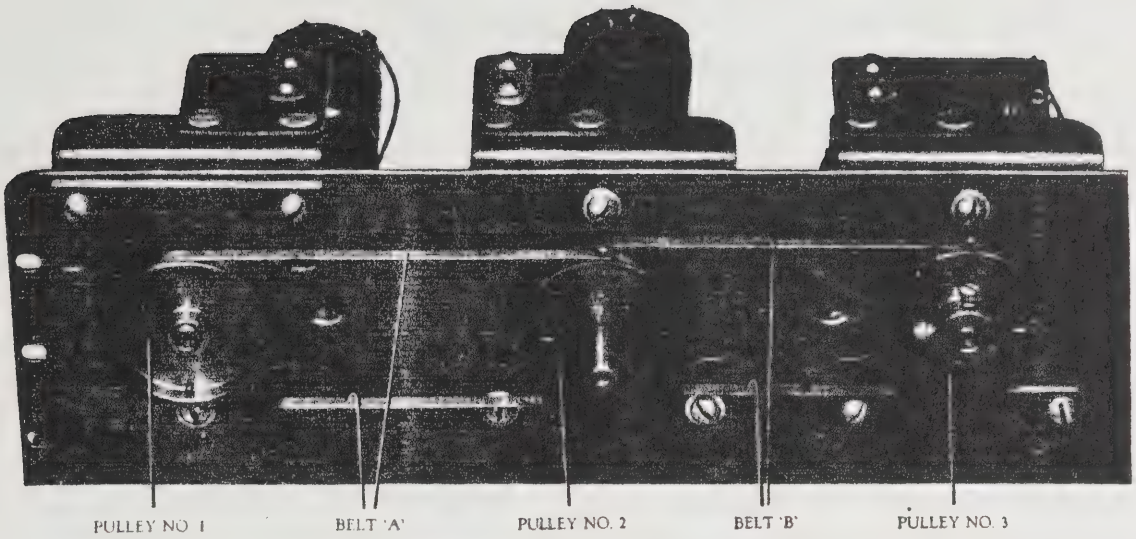


FIG. 93. VIEW OF 37 CHASSIS, SHOWING HOW PULLEYS AND BELTS ARE MOUNTED. The same arrangement is used in Models 30, 35, 40, 41, 42, 48, 50 and 52.

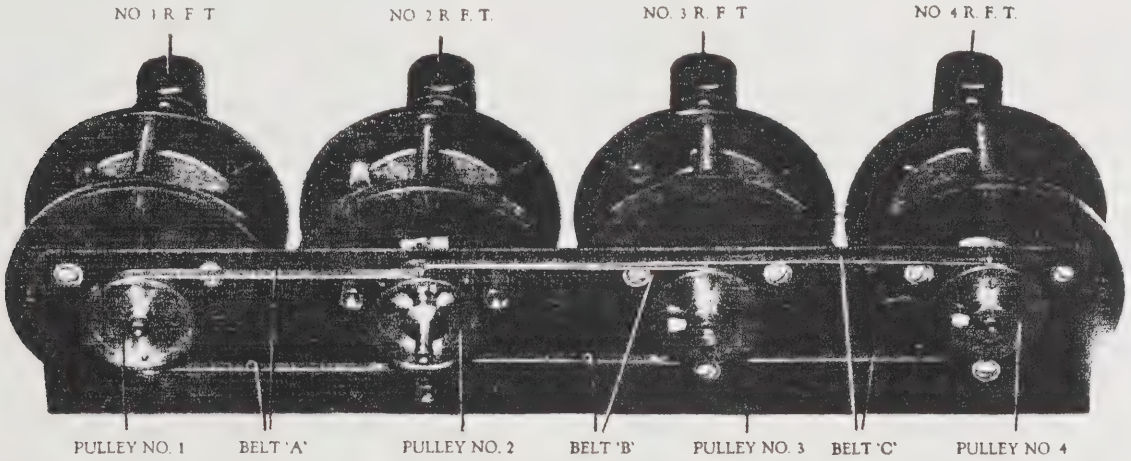


FIG. 94. FRONT VIEW OF MODEL 32 SUB-PANEL ASSEMBLY. The same arrangement of pulleys and belts is used on Models 33, 36 and 49, except that the dial-condenser pulley is usually placed with the hollow side toward the condenser.

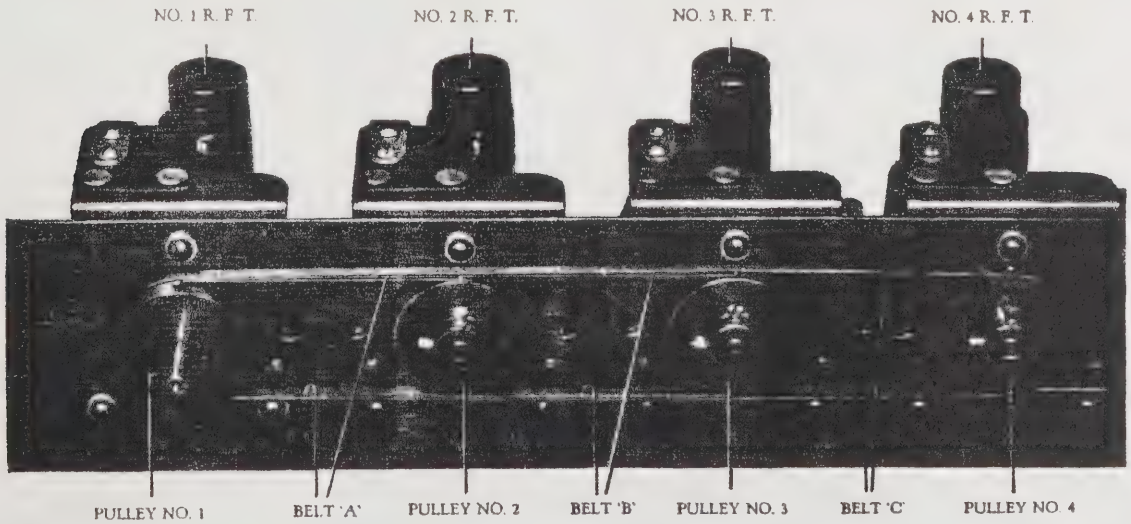


FIG. 95. FRONT VIEW OF MODEL 38 CHASSIS. The pulleys and belts on Model 44 are arranged in a similar manner.

SECTION XII
Model 41 Direct Current Receiver

General Description

The Model 41 is a seven tube receiver similar in appearance to Model 40, but designed to operate on 110 volts **Direct Current** (D. C.). The power unit and filament circuits are therefore quite different from those in the A. C. sets, and owing to the low maximum voltage available for plate supply, the audio frequency circuit is arranged differently from that in the battery type and A. C. electric sets.

Since the power supply for this set is direct current, and D. C. type tubes are used throughout, the function of the power unit is simply to act as a filter to smooth out the current as received from the original source, and reduce and distribute it as necessary for the plate and filament supply of the tubes.

As will be noted from the simplified diagram (Fig. 96), the power unit consists of the following parts:

(a) 2 R. F. Chokes, one in each side of line.
(b) 2 A. F. Filter Chokes connected in series in positive side of line.
(c) 3 Fixed Condensers connected across line at points between the series of choke coils.
(d) A Series Resistor, mounted on outside of power unit at one end, and connected in series with one side of the D. C. line. The purpose of this resistor is to reduce the line voltage to a value such that, when all the tube filaments are connected in series across the line, each will receive approximately its rated voltage.
(e) Output choke, through which the filtered positive voltage is applied to the plates of the two last audio tubes.
(f) Detector plate voltage resistor. This is mounted along with the R. F. chokes (a) on the lower side of the power unit panel assembly.

It will be noted that the audio amplifier tubes receive practically the full line voltage as their plate supply, except that there is a slight drop in voltage in passing through the filter system.

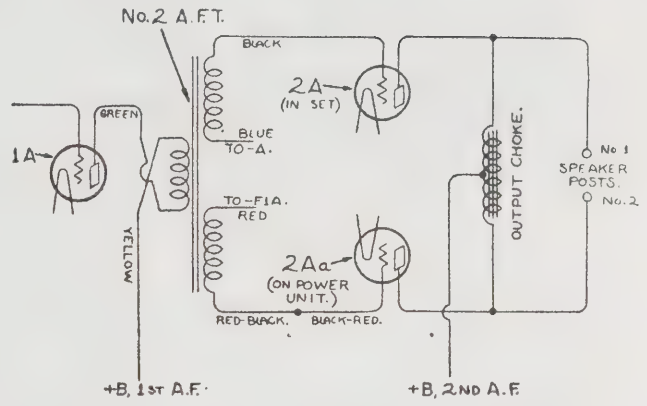


FIG. 97. SCHEMATIC DIAGRAM OF THE "DOUBLE AUDIO" 2ND A. F. STAGE IN MODEL 41.

The series resistor reduces the 110-volt supply to 35 volts, and this 35 volts is applied to the terminals of the filament circuit of the set, which includes the filaments of all the seven tubes in series. Since in accordance with a fundamental law of electricity this voltage is divided among the filaments, each receives approximately 5 volts. To further equalize the voltage on the tubes, shunt resistors are connected across some of the tube filaments. Without these resistors, the tubes at the negative end of the series would receive the highest voltage, due to the cumulative addition of the plate currents.

The audio amplifier system used on the Model 41 is somewhat different from that used on previous models. The first stage of audio is the same, but the second stage consists of two of the 171-A type tubes arranged with a double secondary audio transformer, as shown in the diagram, Fig. 97. The additional tube socket required is mounted on the outside of the right hand end of the power unit.

(Continued on page 94.)

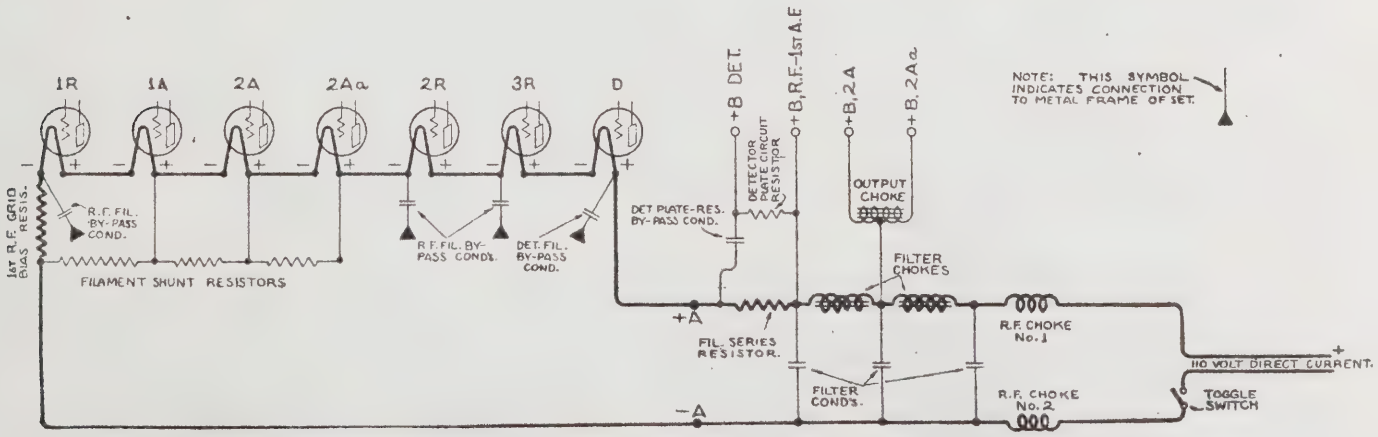


FIG. 96. SIMPLIFIED DIAGRAM OF POWER UNIT AND FILAMENT CIRCUIT IN MODEL 41 RECEIVER.
Tubes of the 112-A type are used in all sockets except 2A and 2Aa.

Continuity Test Table and Chart—Model 41 D. C. Set

(For Following Tests, Remove Cable Panel from Power Unit. Colors Refer to Cable Leads)

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
Each cable lead end to corresponding soldered cable connection under set (except yellow, and black-red tracer).	*Full*	Open in cable or connection.	**Examine cable for broken leads and short circuits. Repair or replace cable if necessary.**
GROUND POST to Metal Chassis.	*Full*	Open connection.	Examine lead from volume control to metal chassis.
Black.	*None*	Shorted R.F. by-pass condenser, grounded fil. circuit, or grounded A.F. grid. circuit.	**NOTE.—If a by-pass condenser is thought to be defective, unsolder its lead from rest of circuit and test condenser separately.**
White.	*None*	Shorted R.F. by-pass condenser, or grounded R.F.-1st A.F. plate circuit.	
Black-Red Tracer.	*None*	Grounded secondary No. 2 A.F.T.	
Yellow.	*None*	Grounded detector plate circuit.	
+FD	*None*	Shorted detector filament condenser.	
—F3R	*None*	Shorted R.F. by-pass condenser.	
Stator Each Var. Cond.	*None*	Shorted variable condenser.	Or grounded R. F. grid.-fil. circuit.
Top Cont. of Vol. Cont.	*Nearly Full*	Open resistance unit in volume control.	
Antenna Terminal. (Turn Volume Knob.)	*Smooth and Nearly Full*	No reading—open res. winding. Erratic reading—damaged winding or slider.	
Center (Tap) Contact On Ant. Coup. Trans.	*None*	Shorted volume control condenser.	
BLACK to Red-White Tracer.	*Nearly Full*	Open filament shunt resistor.	
—F1R	*Full*	Open 1st R.F. grid bias resistor.	Green (or black) covered wire.
+F1A	*Nearly Full*	Open between +F1A and contact No. 2.	
—F2A	*Nearly Full*	Open connection between +F1A and —F2A.	
+F2A	*Nearly Full*	Open between +F2A and contact No. 3.	
—F2R	*Nearly Full*	Open between —F2R and contact No. 4.	
G1R	*Nearly Full*	Open antenna coupling transformer.	
G2R	*Partial*	None—Open secondary No. 1 R.F.T. or open No. 1 grid resistor.	Full-Shorted grid circuit or resistor.
G1A, G2A	*Partial*	None—Open secondary No. 1, 2 A.F.T.	Full—Shorted secondary.
YELLOW to PD	*Partial*	None—Open primary No. 1 A.F.T.	Full—Shorted primary.
YELLOW to —FD	*None*	Shorted phone condenser.	
WHITE to P1R	*Partial*	Open primary No. 1 R.F.T.	Or open 1st R.F. plate resistor.
P2R, P3R	*Full*	Open primary No. 2, 3 R.F.T.	
P1A	*Partial*	None—Open primary No. 2 A.F.T.	Full shorted primary.
OTHER TESTS			
+F1R to —F1A	*Full*	Open connection.	
+F2R to —F3R	*Full*	Open connection.	
+F3R to —FD	*Full*	Open connection.	
G3R to —F3R	*Partial*	None—Open secondary No. 2 R.F.T. or open No. 2 grid resistor.	Full—Shorted grid circuit.
Stator of Det. Var. Cond. to GD	*None*	Shorted grid condenser.	
Stator of Det. Var. Cond. +FD	*Full*	Open secondary No. 3 R.F.T.	

NOTE.—The readings vary somewhat, depending on the resistance of the meter.

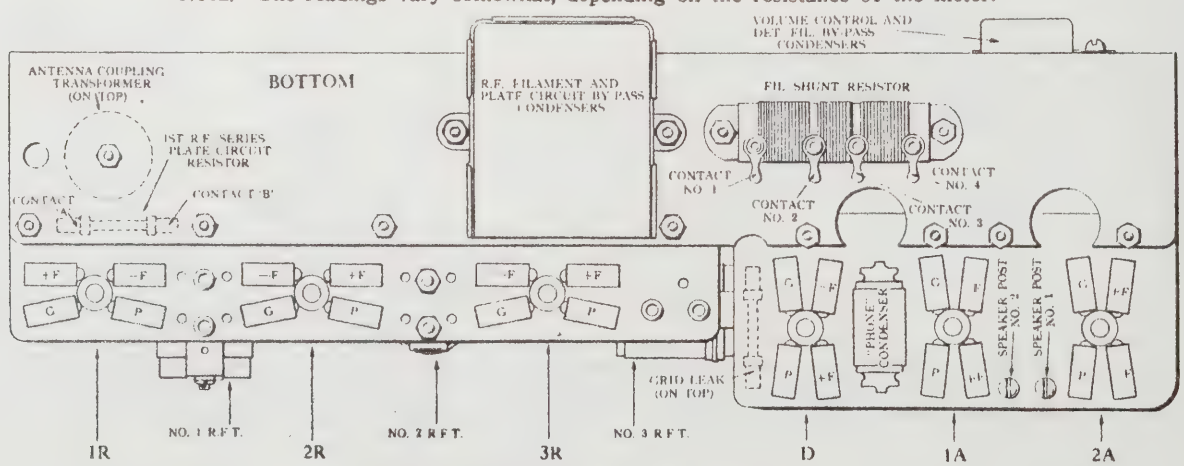


FIG. 99. TESTING CHART FOR MODEL 41.

(Note that the filament contacts of sockets 1-R and 2-A are reversed from the usual polarity.)

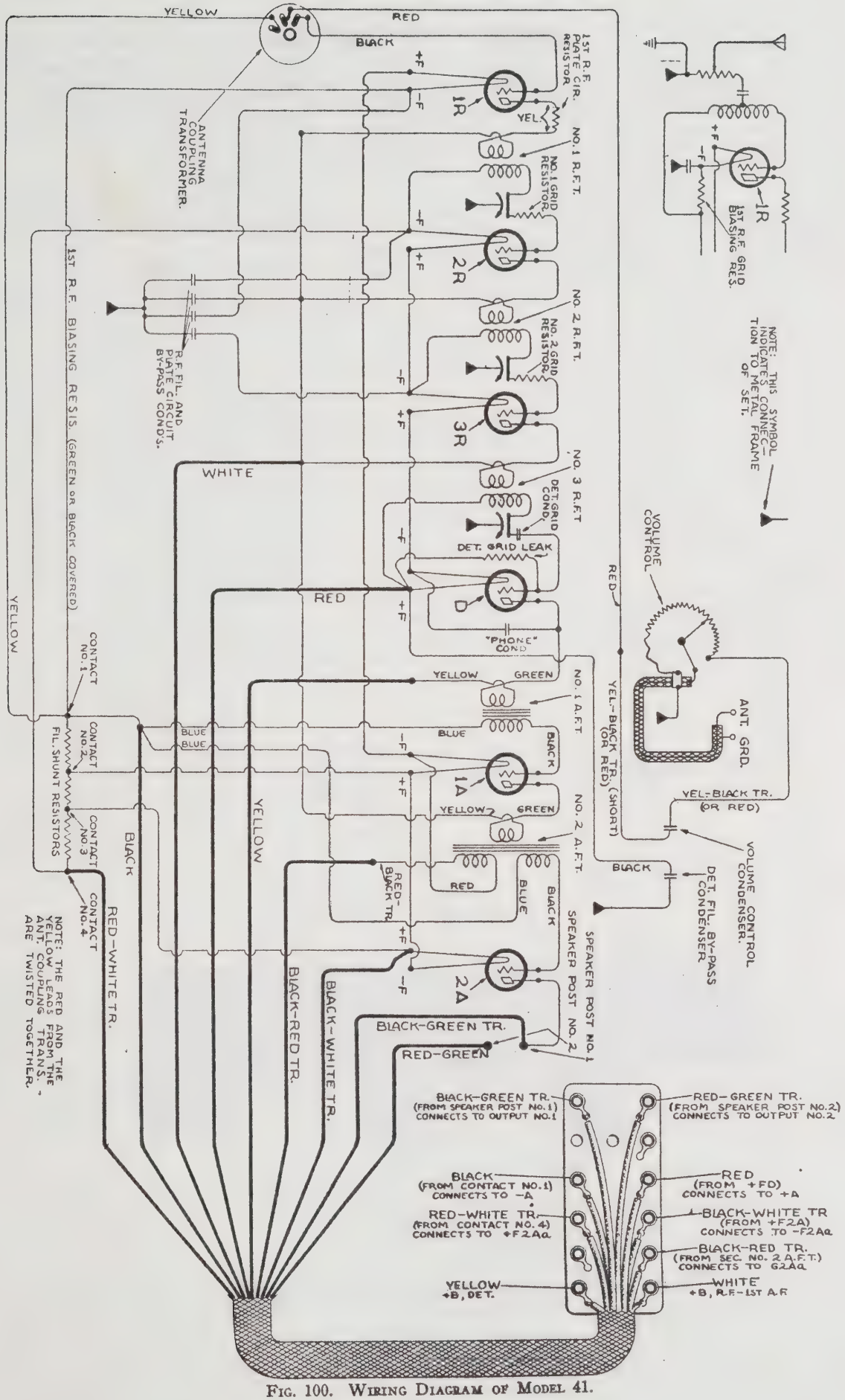


FIG. 100. WIRING DIAGRAM OF MODEL 41.

Due to the comparatively low plate voltage available (approximately 90 volts after filtering) two stages of straight audio amplification connected in standard fashion, would not provide sufficient undistorted output volume. The use of two tubes in this 2nd A. F. "double audio" arrangement causes the available undistorted volume to be equal to that of the A. C. sets, although the plate voltage is much lower.

Special Notes on Installation

The service man should be familiar with several special points which must be observed in connection with the satisfactory installation of Model 41.

REVERSING PLUG: If the set does not operate when first installed (although the tubes light), reverse the two-pronged plug into the electric socket, so that the current flows in the proper direction.

USING COUNTERPOISE: In some cases where an unpleasant hum is experienced in reception, this can be overcome by the use of a "counterpoise" instead of a ground connection. A counterpoise consists of a length of insulated wire connected to the ground post of the set, the other end being open. This wire can be strung in any convenient manner, preferably in a straight line, or nearly so.

DETECTOR CAP: The metal cap furnished with the set (in small envelope) should be placed over the detector tube, which is fourth from left. This will prevent microphonic noises, such as a howl or hum.

Removing Chassis from Cabinet Replacing Variable Condensers

Instructions for removing the chassis from cabinet and for replacing the group of variable condensers are the same as given on page 63 for Model 42.

Replacing R. F. Amplifier Assembly

If one R. F. transformer is defective, replace the R. F. amplifier assembly, an illustration of which is shown in Fig. 98.

Procedure: Remove chassis from cabinet. Unsolder four leads from by-pass condensers, and filament leads at filament contacts —F1A and —FD. Unsolder lead from the secondary of No. 3 R. F. T. at filament contact +FD. Loosen lower nut on rear of each variable condenser and remove the secondary lead lugs. Unsolder green (or black) insulated resistance wire from —F1R and unsolder blue lead from —F2R. Unsolder white cable lead and yellow lead of No. 2 A. F. T. from the exposed section of the +B, R. F lead at the right hand end of the R. F. assembly. Unsolder leads to contacts "A" and "B" on R. F. plate circuit resistor. Unsolder black lead from antenna coupling transformer at G1R and unsolder leads from grid resistors at contacts G2R and G3R.

Unscrew four bolts holding the assembly and the 1st R. F. series plate resistor strip, then remove the assembly.

Reassemble with replacement R. F. amplifier, reversing above procedure. Replace the 1st R. F. resistor mounting strip.

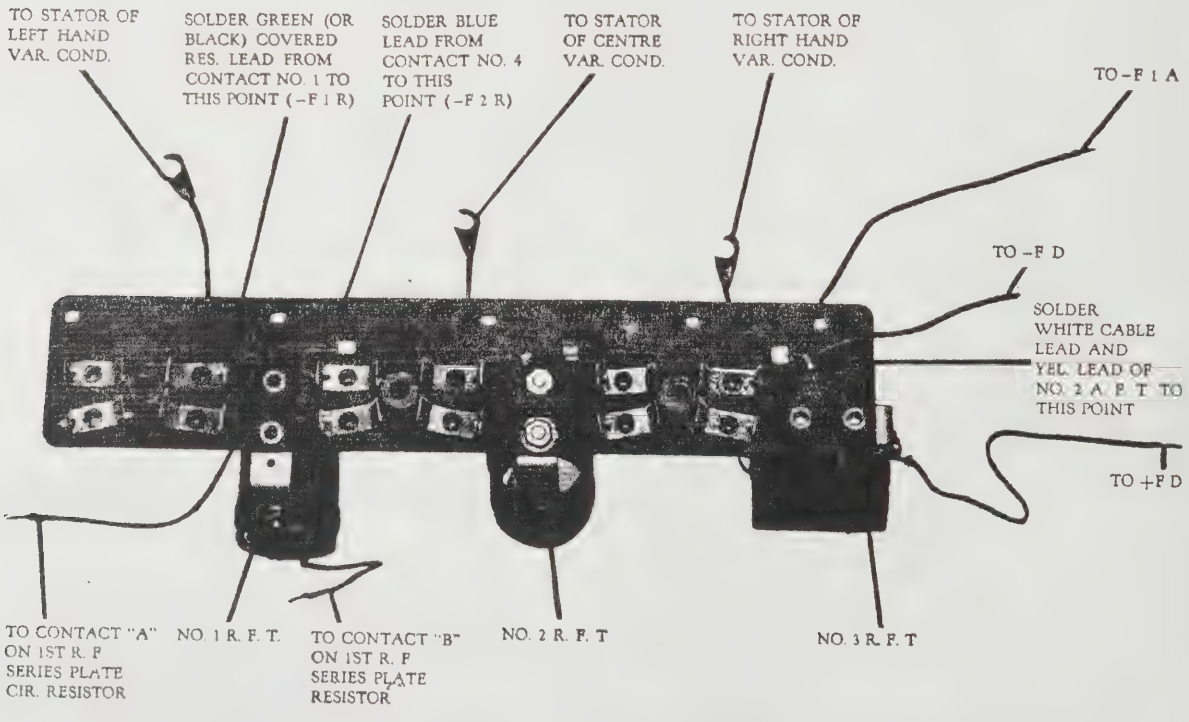


FIG. 98. VIEW OF R. F. AMPLIFIER ASSEMBLY, SHOWING WHERE EACH LEAD IS TO BE CONNECTED.

Voltage Test Table

ATWATER KENT DIRECT CURRENT RECEIVERS

All Measurements Made While Set Is in Operation
Use high-resistance D. C. Voltmeter‡

Voltage at Power Unit Panel Assembly.	APPROXIMATE VOLTAGE Models 41-51
—A to +A.	35 V.
—A to +B, R.F.-1st A.F.	90 V.
—A to +B, Detector.	60 V.
—A to Output No. 1.	95 V.
—A to Output No. 2.	95 V.
Filament Voltage at Set.*	
—F1R to +F1R (1st R.F. Filament).	4.8 V.
—F2R to +F2R (2nd R.F. Filament).	4.9 V.
—F3R to +F3R (3rd R.F. Filament).	4.6 V.
—FD to +FD (Detector Filament).	4.6 V.
—F1A to +F1A (1st A.F. Filament).	4.9 V.
—F2A to +F2A (2nd A.F. Filament).	4.8 V.
Grid Bias at Set.*	
—F1R to G1R (1st R.F. Bias).	2 V.
—F1A to G1A (1st A.F. Bias).	4.8 V.
—F2A to G2A (2nd A.F. Bias).	9.7 V.
Plate Voltage at Set.*	
—F1R to P1R (1st R.F. Plate).	60 V.
—F2R to P2R (2nd R.F. Plate).	65 V.
—F3R to P3R (3rd R.F. Plate).	65 V.
—FD to PD (Detector Plate).	24 V.
—F1A to P1A (1st A.F. Plate).	81 V.
—F2A to P2A (2nd A.F. Plate).	81 V.
Voltage at 2nd A.F. Tube on Power Unit.*	
—F to +F (Filament Voltage).	4.8 V.
—F to G (Grid Bias Voltage).	9.7 V.
—F to P (Plate Voltage).	85 V.

* Contact made through socket eyelets. ‡ The readings in the table were taken with a Weston No. 489 (0—50—250) voltmeter. Other types of voltmeters may give slightly different values.

Model 51. The Model 41 receiver is also manufactured in a thirty-inch high metal cabinet like that of Model 52. This receiver is known as Model 51. The chassis is identical with Model 41, except that the shielded antenna lead is not used—instead, two twenty-foot leads are furnished for connection to the regular antenna and ground. The speaker in Model 51 is the same as in Model 52—service instructions for this type speaker are given on page 83.

Power Unit in Direct Current Receivers

General Information

A simplified circuit diagram of the power unit used in the Atwater Kent Model 41 direct current receiver is shown in Fig. 96. A wiring diagram of one of the first units of this type is shown in Fig. 103. Slight modifications were made subsequently in order to improve the reliability of the unit. The modified arrangements are shown in Figs. 101 and 105.

A socket for one of the 2nd A. F. amplifying tubes is mounted at the right hand end of the power unit. A filament series resistor (similar in appearance to the regulating resistor in A. C. power units) is mounted at the left hand end of the unit.

Instructions for removing the power unit from cabinet are similar to those given on page 69 for Model 42 unit.

Testing

Apply the continuity tests given in the table on this page. If the tests indicate that the filament series resistor, detector plate circuit resistor or one of the R. F. choke coils is defective, it may be replaced. If anything is defective in the A. F. filter chokes or condensers, which are sealed in the metal container, a new sealed container should be substituted.

Replacing Sealed Power Unit Container

Remove the lid of unit and the filament series resistor. Unsolder leads from sealed container at panel assembly. Unsolder four leads from tube socket contacts and the two primary winding leads where one connects to the toggle switch and the other connects to one side of the 110-volt supply cable.

Remove two screws holding socket to angle bracket and remove socket. Pull the power-unit cable leads up through the hole in tube socket angle-bracket and pull the red-green tracer lead and the primary winding leads up through the cable covering. Remove the panel assembly with attached power-unit cable leads. (In the early type of unit shown in Fig. 103, the primary winding leads are not brought through the power unit cable.)

Reassemble with replacement sealed container, reversing the above procedure. Note that the red-green tracer lead and the primary winding leads from the replacement sealed container should be brought through the power-unit cable. This may be accomplished with the aid of a piece of bus-bar, hooked at one end, by pushing the bus-bar up through the cable from the socket end, fastening the lead to the hook, and pulling the bus-bar back again, thus drawing the lead through the cable covering.

Note.—In servicing or assembling the direct current power unit, make certain that the R. F. choke coil contacts do not make accidental connection with any of the terminals on the panel assembly.

Continuity Test Table for Direct Current Type Power Unit

For Following Tests, Remove Cable Panel from Power Unit

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
Each Socket Contact to Corresponding Terminal on Panel.	*Full*	Open in lead or connection.	
Test Across Contacts on Each R.F. Choke.	*Full*	Open R.F. choke.	
+B R.F.-1st A.F. to			
+110 Volt Input.	*Nearly Full*	None—Open filter choke or connection.	
+B Detector.	*Partial**	None—Open detector plate circuit resistor.	Nearly Full—Shorted detector by-pass condenser.
+A	*Nearly Full*	None—Open filament series resistor.	Examine resistor carefully to see if it is open, shorted, or damaged in any way.
—A	*None*	Shorted filter condenser or shorted pos. cir.	
Output No. 1.	*Nearly Full*	None—Open output choke or connection.	
Output No. 2.	*Nearly Full*	None—Open output choke or connection.	
—A to —110 Volt Input.	*Full*	Open connection in negative line.	
Exposed Edge of Metal Container to —A, +A	*None*	Grounded circuit.	Examine power unit wiring for external grounds. If ground is internal, replace the sealed container.

* If using a low-resistance testing voltmeter, this reading will be "small."

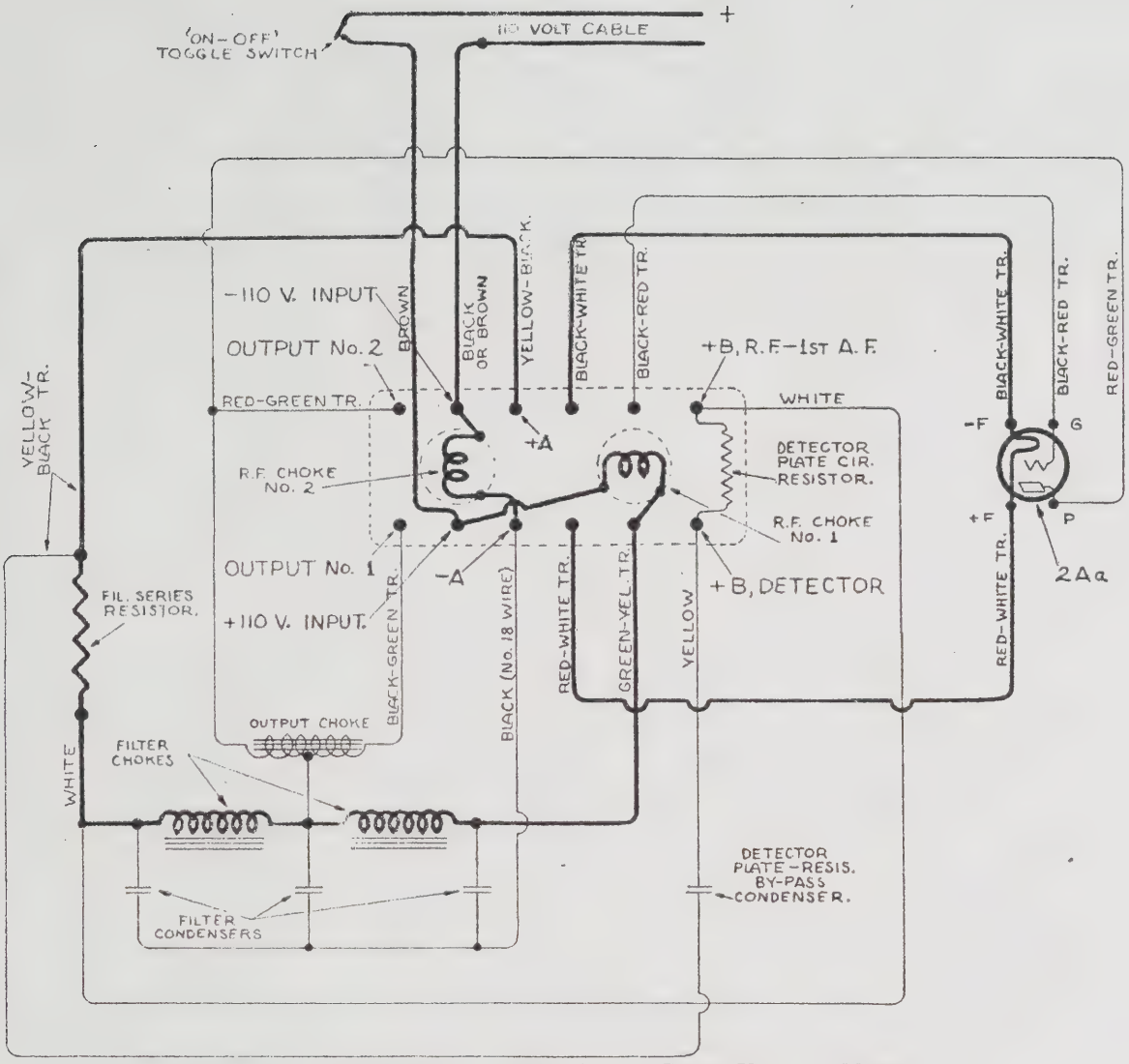


FIG. 101. WIRING DIAGRAM OF 3RD TYPE OF POWER UNIT FOR MODEL 41.

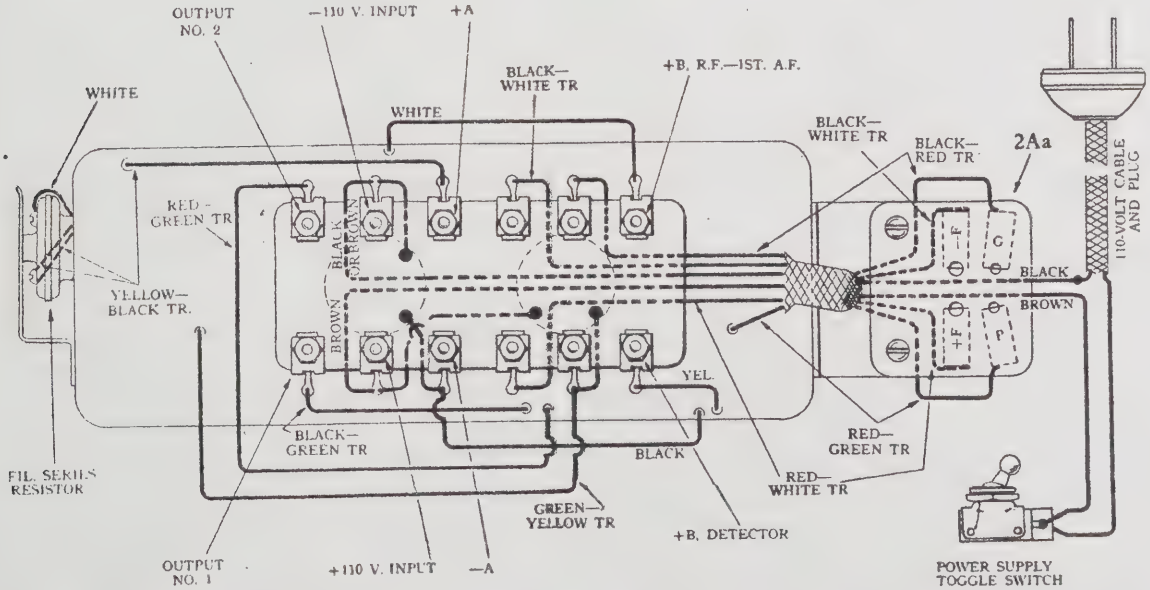


FIG. 102. SHOWING CONNECTIONS AND APPROXIMATE POSITION OF LEADS FROM SEALED CONTAINER IN 3RD TYPE OF POWER UNIT.

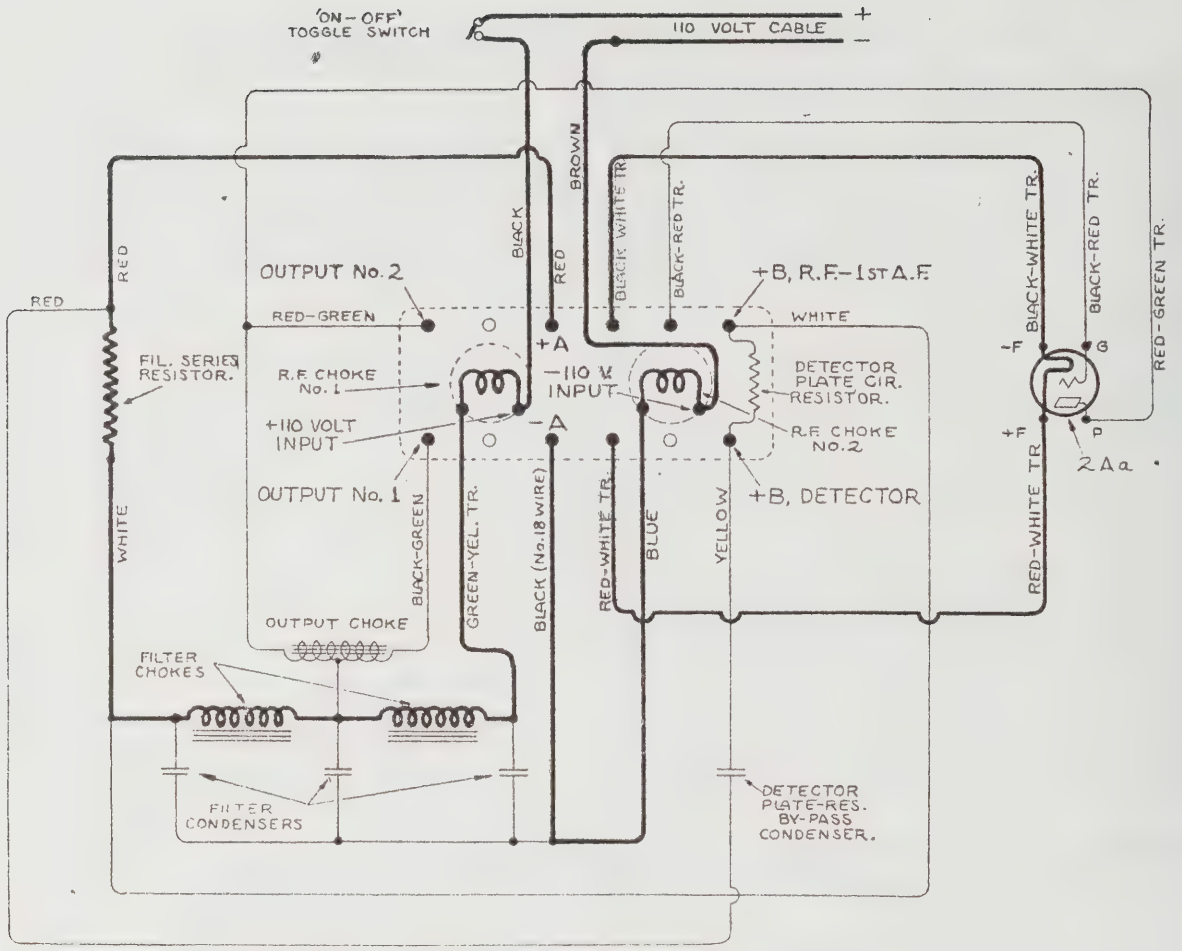


FIG. 103. WIRING DIAGRAM OF 1ST TYPE OF POWER UNIT FOR MODEL 41.

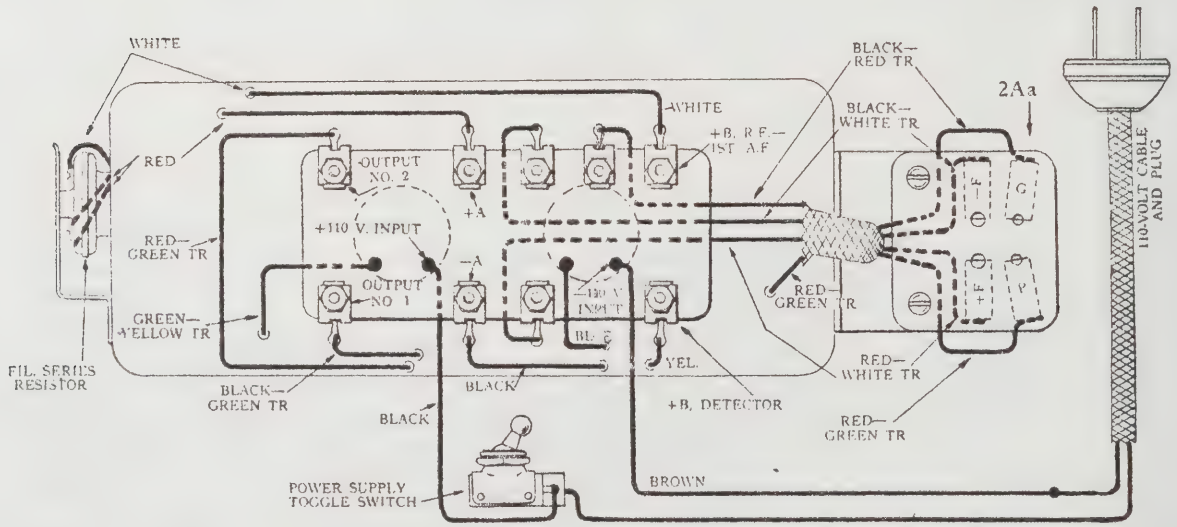


FIG. 104. SHOWING CONNECTIONS AND APPROXIMATE POSITION OF LEADS FROM SEALED CONTAINER IN 1ST TYPE OF POWER UNIT.

NOTE.—Complete direct current power units of the 1st, 2nd and 3rd type are interchangable in Model 41 receiver. Only the 3rd type is supplied as replacement.

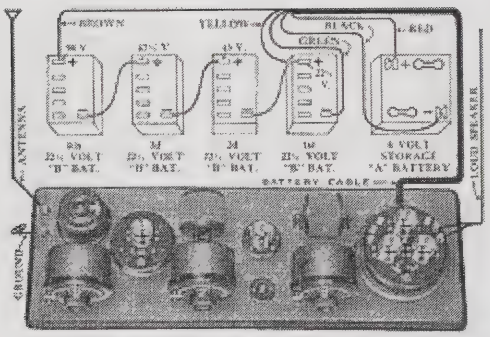


Illustration 16—FOR MODELS 9 AND 10

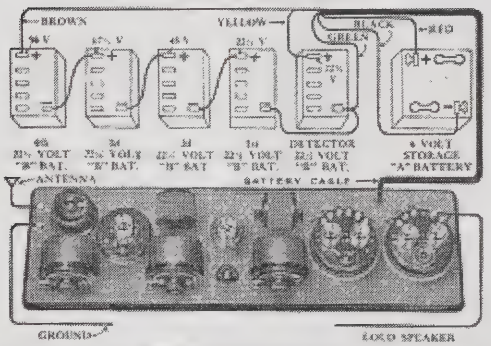


Illustration 17—FOR MODEL 11

NOTE—A separate 22½ Volt, dry cell "B" battery must be used for the Detector Tube, with the Model 11 Receiver.

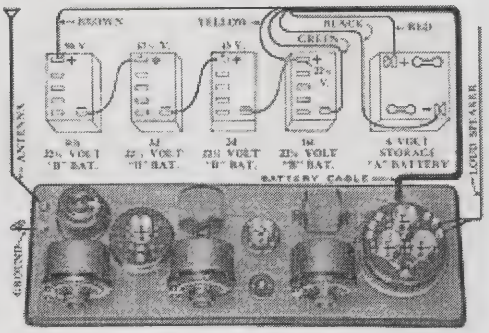


Illustration 16—FOR MODELS 9 AND 10

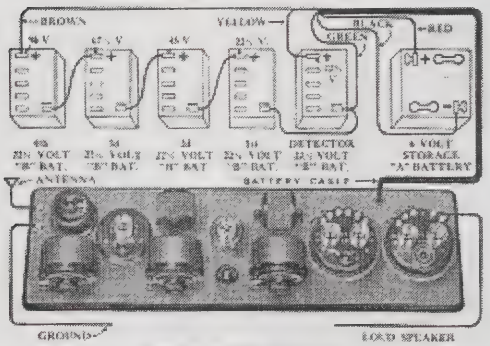


Illustration 17—FOR MODEL 12

NOTE.—A separate 22½ Volt, dry cell "B" battery must be used for the Detector Tube, with the Model 12 Receiver.

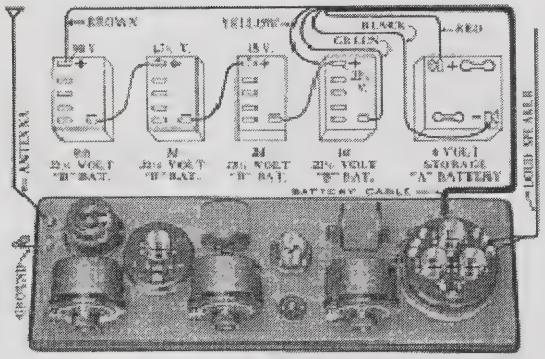


Illustration 16—FOR MODELS 9 AND 10

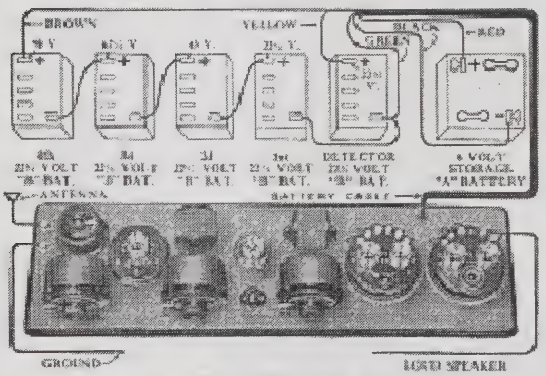


Illustration 17—FOR MODEL 12

NOTE—A separate 22½ Volt, dry cell "B" battery must be used for the Detector Tube, with the Model 12 Receiver.

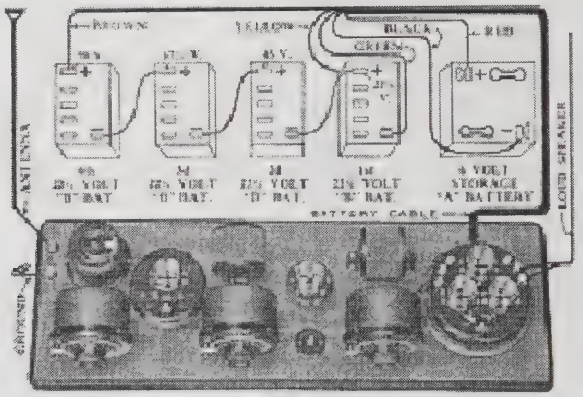


Illustration 16—FOR MODELS 9 AND 10

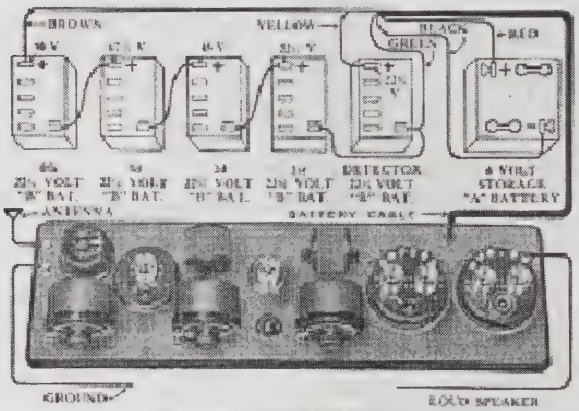


Illustration 17—FOR MODEL 12

NOTE—A separate 22½ Volt, dry cell "B" battery must be used for the Detector Tube, with the Model 12 Receiver.

ATWATER KENT
RADIO
SERVICE MANUAL

ATWATER KENT MANUFACTURING COMPANY
4700 WISSAHICKON AVENUE, PHILADELPHIA

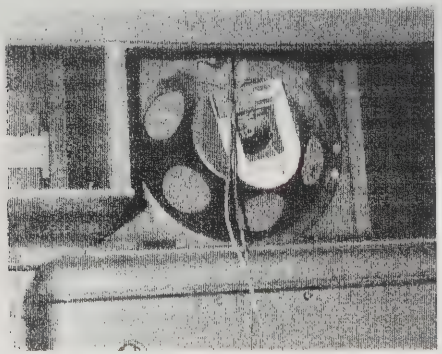


Figure 6. A rear view of the electromagnetic speaker, mounted just above the Model 40 receiver.

(Atwater Kent Model 40, continued)

Cross, the NBC Symphony under Arturo Toscanini, and the Sunday afternoon concerts by the New York Philharmonic. She remembers that the December 7, 1941, Philharmonic broadcast was interrupted with the news of Pearl Harbor.

With so many different programs on the air, it was inevitable that conflicting interests would develop, and so eventually two more radios entered our home. One was a late 1930s, white Bakelite, Firestone table model, which allowed my sister to enjoy her classical music programs in the privacy of her own room. The other was a 5-tube AC-DC kit from Allied that I built as a 1941 Christmas present for my mother. This immediately became *her* kitchen radio and also a mainstay, as she did the ironing for a family of eight.

The Atwater Kent Model 40 continued to serve faithfully in our home until 1984, when my mother could no longer live alone and maintain the place. I still have visions of her, as, for decades, she ritually dusted and polished every inch of the ornate cabinet. Thanks to her loving care, the Pooley cabinet still looks as if it just came out of the showroom.

We were not a well-to-do family, and I still wonder how my folks with four kids at the time could have afforded this radio. A Pooley ad in *A Blast From the Past*, page 22, states "The new Pooley – Model 7500 – Spanish Chest Radio Cabinet. Price, with card and pipe racks, but without receiving set or speaker. $105."

The cabinet houses the Model 40 Atwater Kent metal "breadbox" radio which is easily removed, dial panel and all by sliding it out of the cabinet, as shown in Figure 5. Figure 6 shows a rear view of the electromagnetic speaker, mounted directly above the AK 40. An ad from Alan Douglas' Volume 1 of *Radio Manufacturers of the 1920's* declares, "Model 40 - AC. A powerful, compact, all electric receiver in a satin-finished shielding cabinet. Full vision dial. Uses six AC tubes and 1 rectifying tube. Without tubes. $77."

> **Mr. Atwater Kent says:**
> **"The new line of Pooley Radio Cabinets is certainly very interesting and should appeal to all those who want the highest type of modern radio furniture.**
> **"For this reason, I heartily approve of their use with Atwater Kent Radio of 1928-29."**
>
> **(Signed)**
> **A. Atwater Kent**

Considering the cost of the cabinet at $105, the radio at $77, and the tubes and speaker at an estimated $50, the total price, not including the antenna installation, comes to approximately $232. In 1928, that was a lot of money for an itinerant grocer with a growing family. My brother speculates that Dad, always a frugal businessman, probably made a good deal with a supplier or customer in financial difficulty.

Of course, the sentimental value of this set 69 years later is priceless. But what, out of curiosity, will the cash value of this radio be in the year 2028, when it will be 100 years old? Already this radio has been in our family for three generations. Hopefully, on its 100th birthday, it will still be in our family to be treasured and enjoyed by the next generation of proud owners.

This radio is now understandably the focal point of my modest collection. Not surprisingly, it has also influenced my tastes in radio collecting. The majority of my radios from breadboard to tombstones and cathedrals are — you guessed it — Atwater Kents. Not to mention AK horns, service manuals, AK advertising, including an AK advertising whistle, and a cookie jar that resembles an Atwater Kent Model 84 cathedral radio.

RESTORATION OF THE ATWATER KENT MODEL 40

The Atwater Kent Model 40 was a workhorse. For a dozen years or so, this was the only radio in our home. Yet, during my childhood and early teen years, I recall only two occasions when the Model 40 failed us.

Those were the days of radio service house calls. I can still envision the radio repairman entering the house with his impressive tube caddy and test instruments. On both house calls the repairs were minimal. The first visit required a tube replacement. On the second visit a few years later, it was necessary to splice a broken copper drive belt which, with one other belt, synchronized three variable tuning condensers.

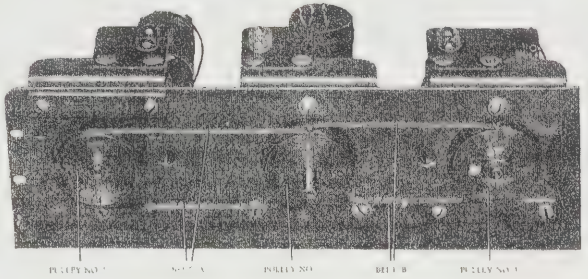


Figure 7. The pulley and belt arrangement for the Model 40 and other sets in the "breadbox" series from the Atwater Kent service manual. Note the pins at the top of the center and the right-hand pulleys used to engage the drive belts.

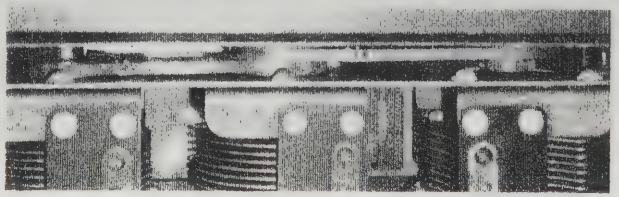


Figure 8. The upper portion of the photo shows both copper belts in place. These belts are properly seated over the pins on the pulleys of the three variable condensers in the lower portion of the photo. Note the old solder splice, still intact, on the bottom belt, in the center of the photo.

In recent months, with the writing of this article and in planning an exhibit of my collection at the local historical society museum, I found the motivation to restore the family heirloom to operating condition. Not surprisingly the needed repairs were relatively minor. In testing the 7 tubes (Types 226, 1st RF; 226, 2nd RF; 226, 3rd RF; 227, detector; 226, 1st AF; 171A, 2nd AF; and 280, rectifier), only the 1st RF tube (Type 226) needed replacement.

Having set my trusty variac at low voltage, I turned the radio on, gradually increasing the voltage. At 120v AC the set was drawing about ½ amp, a reassuring level that indicated the power supply was OK. But there was no sound. A quick continuity check showed that both wires leading from the speaker to the chassis were broken where they were attached to the phone tips. With these repaired, it was rewarding to hear some noises from the speaker, but most of the noise came from the very scratchy volume control. The simple process of removing the volume control and spraying the wiper of the rheostat with contact cleaner practically eliminated the scratching problem.

However, reception left much to be desired, with only one or two stations being received. I recalled that one of the dial-drive belts had been spliced years ago, so I thought at first that this belt had broken again, thus causing the three variable condensers to be unsynchronized. Fortunately, the belt was not broken, but it was very loose, causing the belt to override the pins which project from the center and right-hand pullies, shown in Figure 7.

The question now became how to tighten the tension of this loose drive belt. Fortunately, my Atwater Kent *Service Manual and Parts List* gives precise, if primitive, step-by-step instructions for tightening belt tension, as noted in the following paragraphs. The first paragraph gives "generic" instructions, while the second paragraph provides more specific instructions for the Model 40.

ADJUSTING BELT TENSION

"In Atwater Kent single-dial receivers having metal frame variable condensers, a hole is provided in the front of the chassis at the edge of each condenser. The hole is placed on that side of the condenser which is nearest to the dial-condenser. The frame of the condenser partly covers the hole. By inserting the blade of a screw driver (held in the left hand) in this hole and twisting the blade, the condenser may be moved away from the dial-condenser, thus tightening one belt. When the condenser is moved to the point giving the correct belt tension, keep the condenser in that position, and then with another screwdriver in the right hand, tighten the three screws that hold the condenser to the chassis."

For the Model 40, "Adjust the right-hand belt first. Insert the blade of a screw driver in the chassis hole at the left-hand edge of the third condenser. Twist the blade slowly, forcing the third condenser toward the right until the belt seems to have the correct tension, as judged by the finger. Hold the condenser in that position, and with another screw driver, tighten the three screws. Adjust the left belt in the same general way."

Following these basic instructions, I adjusted the belt tension in a matter of minutes, with much improved reception. Figure 8 shows the two copper belts, with the proper tension to provide synchronous tuning of all three variable capacitors.

Since I already had the chassis out of its metal case (the *Service Manual and Parts List* also includes directions for removal of the chassis), I decided to do a little preventive maintenance by replacing the RF filament and plate circuit bypass condensers within the flat metal multicapacitor can bolted to the chassis. With this done, the set was reinstalled in its elegant cabinet, once again the focal point of my collection, in the best historical and nostalgic sense.

Now all I need is a time-warp 100-foot-long, 40-foot-high antenna to pull in the same stations and programs my family listened to so long ago!

References:

Douglas, Alan. *Radio Manufacturers of the 1920's, Volume 1.* Vestal, New York: The Vestal Press, Ltd., 1988.

Kent, Atwater. *Service Manual and Parts List.* Philadelphia, Pa.: Atwater Kent Mfg. Company, 1924-1936.

Wolff, H.G. and I. Jacobson. *A Blast from the Past.* Stillwater, N.J.: Sound of Music.

(Dick Desjarlais, Dick's Radio Days, Box 629, Littleton, MA 01460)

Dick Desjarlais is on the staff of A.R.C. His interest in radio began at age 14 when he was an apprentice in a radio repair shop. In World War II, Dick served as a Sonar Technician in the Pacific Theatre. His radio interest renewed itself when he retired from school administration, and since 1987, he has been an active collector and dealer.

ATWATER KENT

RADIO

SERVICE MANUAL

ATWATER KENT MANUFACTURING COMPANY
4700 WISSAHICKON AVENUE, PHILADELPHIA

ATWATER KENT
RADIO
SERVICE MANUAL

The following pages have been prepared with the idea of enabling the Atwater Kent Radio Dealer to more thoroughly understand the product he is engaged in merchandising, and to more readily locate and correct any condition which might interfere with the proper functioning thereof.

ATWATER KENT MANUFACTURING COMPANY
4700 WISSAHICKON AVENUE, PHILADELPHIA

ATWATER KENT RADIO SERVICE MANUAL

Table of Contents

Form No. Ser. D. 27.

INTRODUCTION

1. Purpose of Service Manual

The object of the Service Manual is to assist the retailer of Atwater Kent radio products in giving prompt and efficient service to the consumer-owner. Since in accordance with our Radio Service Policy, service on Atwater Kent radio products is to be handled by Atwater Kent dealers and distributors only, this publication should be considered confidential and except in special cases, is furnished only to regularly appointed outlets of Atwater Kent radio merchandise.

2. Importance of Service

Service has "come into its own" during the past few years and its importance is continually becoming more widely recognized. The value of prompt and courteous service by the dealer cannot be over-emphasized. Service is closely linked with sales—in fact the one depends on the other. The radio dealer who has foresight will build for the future by maintaining a neat and efficient repair department and employing a competent service personnel consistent with the size of his organization. There is no better step toward building good-will for Atwater Kent products in his immediate locality.

3. Dealer Service Procedure

The dealer who has a reasonably well equipped service shop will find that he is in a position to handle the servicing of practically any set which comes to him for repair, since the bulk of repairs will not be of a difficult nature.

In the event that he is unable to perform a certain repair, the set or unit should be returned to his local distributor, who maintains a complete service department similar to that of the factory. The distributor will furnish his dealers with complete instructions for return of material, such as making out of return report blanks and other routine in connection with the handling of service matters.

4. Dealer's Parts Stock

We strongly urge that every dealer carry in stock a supply of such repair parts as may be most commonly required for the more popular types of Atwater Kent sets and speakers. This will eliminate the possibility of a dissatisfied customer, resulting from the delay necessarily involved in ordering a part from the distributor.

Newly appointed dealers should consult their distributor regarding a suitable initial stock to be carried.

Repair parts must be purchased from the distributor. No parts are sold direct from factory to dealer.

5. Repair Charges—Warranty Repairs

The charge on a repair job for the consumer, on a set beyond the warranty, may be based on the consumer price of the repair parts used, plus a charge for the time required, at a definite rate per hour. The time charge will cover the time consumed in testing the set when repaired, and in calling for and delivering the set, if this is done.

Our factory warranty on new products, involves the replacement of parts defective in workmanship or material, and covers a reasonable length of time. Our distributors are notified by bulletin when certain models pass beyond the warranty period, so that in case of doubt, definite information can always be obtained from the distributor, as to whether a warranty adjustment is in order on a certain model.

In many cases the dealer will find it of advantage to adopt a written "Service Agreement" with the consumer, whereby a charge is made for service calls and repair work after a certain length of time. This will protect both dealer and consumer.

6. Service Policy

A complete printed "Service Policy," definitely outlining the factory's plan on service matters, is sent once a year to our distributors, and such information from this as is required by the dealer will be passed on to him by the distributor. A definite understanding between dealer and distributor on all matters pertaining to service will be the means of preventing much conflict and controversy. It cannot be too strongly urged that all instructions from the distributor be carefully followed, so that complete co-operation will exist. Written instructions, such as bulletins, etc., should be kept handy in a loose-leaf note book.

7. Service Literature

The dealer will do well to keep readily available, ALL literature pertaining to service which comes into his place of business. In addition to the bulletins from your distributor, the factory has a special "Dealer Bulletin Service" which contains various suggestions and ideas along service lines.

There are several excellent monthly radio trade publications which are invaluable to the retail dealer, both from a sales and service standpoint. We believe the small price of annual subscription to several of these magazines will be more than repaid by the excellent information and ideas they contain.

Two or three good text books on radio will also not be out of place on the dealer's book shelf. An easily understandable book on the theory of radio and a practical book on general radio service and repairing are suggested.

8. Factory Service Course

One of the best ways in which the recognized Atwater Kent dealer (or his service man) can familiarize himself more completely with the correct methods of servicing Atwater Kent radio products, is to spend a week or two in our factory Service Department. We have mapped out a "Course" of training to be followed in this work, which completely covers the various steps in repairing, assembling, and testing all models of our Sets, Speakers, and Power Units.

The "Service Course" takes from one to three weeks depending on the ability of the individual. There is no charge for the instructions, but the dealer will naturally furnish the transportation and living expenses connected with this visit to Philadelphia. A letter of introduction from the local distributor is required and must be presented at the factory for identification purposes.

SECTION I

THEORY OF RADIO BROADCAST RECEIVERS

Knowledge of Theory Essential

While the primary purpose of the Service Manual is to instruct the dealer in the testing and repairing of Atwater Kent receiving sets, **we believe that an understanding of the fundamental principles of radio and a knowledge of how our sets function will enable him to perform this work more intelligently.** It is, of course, essential to know what to do to correct troubles, but a knowledge of the theory and functioning of the various units of the set will enable the repairman to locate the trouble more readily. If an unusual condition arises in a set, a repairman without a knowledge of the principles involved, can correct the trouble by "hit-or-miss" methods only. The service man who has this fundamental knowledge can analyze the condition and then determine the remedy.

Fundamental Principles of Electricity Applied to Radio

Radio is based on electricity and a few of the elementary conceptions of its fundamental principles should be understood before going further. Electricity shows many characteristics of a fluid such as water, but unlike water, it apparently has no substance, and its presence can be determined only by the effect. Its force, quantity and other properties, however, can be determined and measured by electrical instruments.

In the pipe line shown in Fig. 1, there is a complete circuit of water which is flowing through the pipes as a result of the force exerted by the pump. The left-hand sketch is a diagram of an electrical circuit in which the electricity is flowing as a result of the force exerted by the batteries. There is a definite amount of water flowing in the pipe line and there is likewise a definite amount of electricity flowing in the electrical circuit.

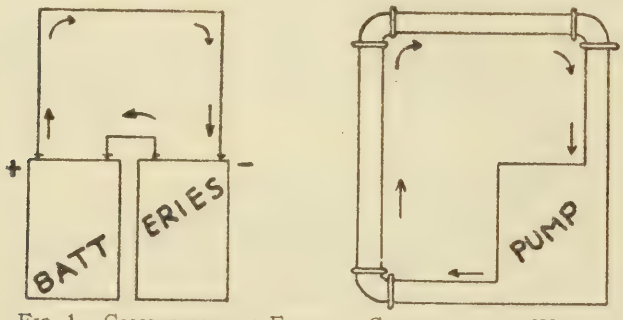


FIG. 1. COMPARISON OF ELECTRIC CURRENT WITH WATER.

The quantity of electricity flowing is measured in units called amperes.

The water has a certain pressure forcing it through the circuit. The electrical circuit likewise has a definite pressure, which is measured in units called volts. In the water circuit there is a certain amount of resistance due to the friction offered to the water by the sides of the pipe. This resistance is obviously greater in a small pipe than in a large one. The electrical circuit likewise has a resistance depending upon the gauge of the wire, its length and the material of which it is made. Electrical resistance is measured in units called ohms.

In the diagram shown in Fig. 1, the water and electricity flow in one direction only. This type of electrical current and all currents produced by batteries is known as direct current.

Alternating Current

Alternating current may be compared to the sort of water flow illustrated in Fig. 2. Instead of being forced continuously in one direction by a pump, it is pushed first in one direction and then the other by the piston "P." If the rate at which the piston moves back and forth is constant, it corresponds to the frequency of an alternating current, which is generally expressed in "cycles" per second.

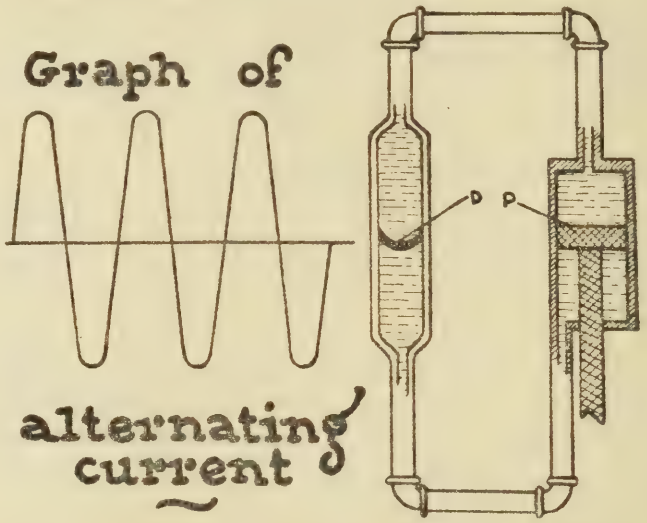


FIG. 2. ALTERNATING CURRENT IS SIMILAR TO ALTERNATING WATER FLOW.

The diagram (Fig 2) is a graphical representation of alternating current. The current is built up to a certain voltage in one direction, falls back to zero voltage, builds up an equal voltage in the other direction, and again returns to zero. The two directions are known as positive and negative, and alternating current consists of a series of such alternations in direction, expressed in cycles per second. In the case of "radio" frequency currents, these alternations are very rapid, the frequency ranging approximately from 500,000 to 1,500,000 cycles per second.

Condensers

The action of the flexible diaphragm "D" illustrates the action of a fixed condenser in a circuit of alternating current. The diaphragm would stop a direct flow of water, but allows it to surge back and forth. A condenser likewise acts as an insulator to a circuit of direct current, but not to a circuit of alternating current of high frequency. It will be seen later how this property of a fixed condenser is used in our receiving sets.

A condenser is fundamentally a unit for storing electricity, and its ability to do this is termed capacity, expressed in units called farads. This is a very large unit, however, and the practical unit of capacity is the micro-farad which is one millionth of a farad.

A fixed condenser (one of constant capacity) consists of two or more parallel metallic plates, which are separated from each other by mica, air or another insulator. The capacity of a condenser depends upon the number and size of the metal plates, the distance between them and the insulating material. In the case of our by-pass condenser, which must have a comparatively large capacity, the metallic portion consists of two layers of thin, pure tinfoil, separated by special impregnated linen tissue. The system of layers is then wrapped as shown in Fig. 3. A condenser made with mica insulators, having the capacity of this by-pass condenser, would be very impractical because it would necessarily be very large.

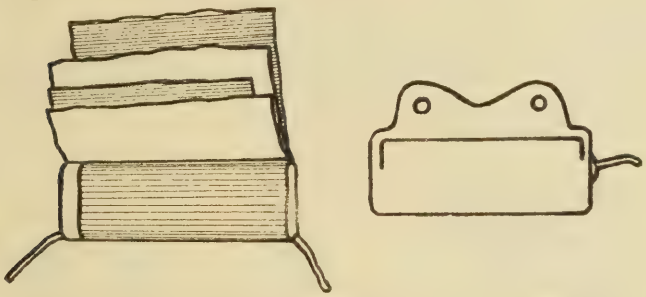


FIG. 3. CONSTRUCTION OF TYPICAL FIXED CONDENSER.

A variable condenser (Fig. 4) is so called because the capacity can be varied. This is accomplished by having two sets of metal plates interleaved with each other and one set revolving on a shaft so that any desired area of the plates can be interleaved. By turning the shaft and revolving one set of plates, the capacity of the condenser is changed to any desired amount within the limits of its total capacity.

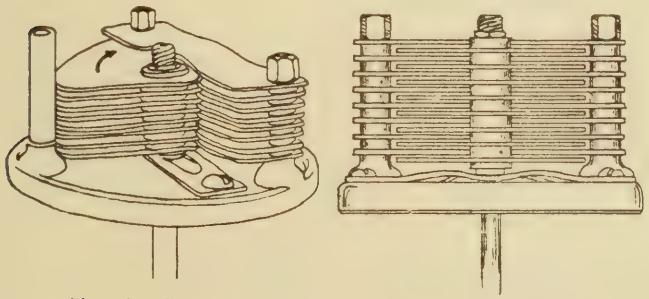


FIG. 4. CONSTRUCTION OF VARIABLE CONDENSER.

Transformers

Transformers are a very important part of a receiving set and when used in connection with a radio tube, serve as a method of amplifying the broadcast signal after it has been picked up. The theory briefly is this: A coil of wire which has an alternating, intermittent, or pulsating current passing through it, sets up a constantly changing electro-magnetic field (lines of force having both electric and magnetic properties). (See Fig. 5.) If another coil of wire is placed in this electro-magnetic field, a current will arise in and flow through this second coil, even though there is no physical connection to the first. This transfer of electric energy takes place by what is called "induction." The voltage "induced" in the second

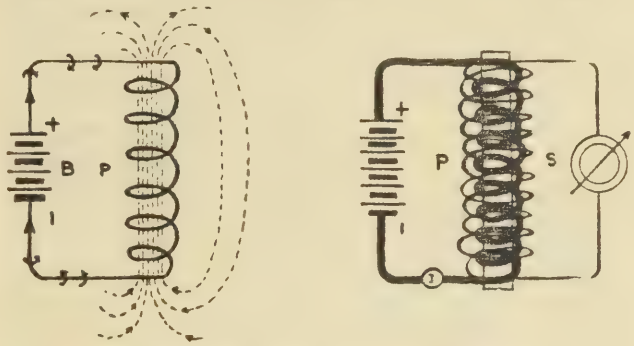


FIG. 5. ELECTROMAGNETIC INDUCTION—ACTION OF A TRANSFORMER.

coil may be made considerably greater than that in the first coil by having a greater number of turns of wire in the second. For ordinary alternating and intermittent current, the two coils of wire (which are called primary and secondary) are wound around a soft iron core, which greatly strengthens the electro-magnetic field and increases the efficiency of the transformer. The two windings are insulated from each other and also from the core.

Audio Frequency Transformers

Our audio transformer No. 7661 (See Fig. 6) consists of a soft iron core made of a number of soft iron wires, a primary winding of about 6,000 turns of wire and a secondary of 15,000 turns of wire (gauge 40). The ratio of the number of turns of secondary to primary is 2.5 to 1, which is likewise the ratio of output to input. The first stage transformer (No. 8060) has a ration of about 4 to 1. (Fig. 7).

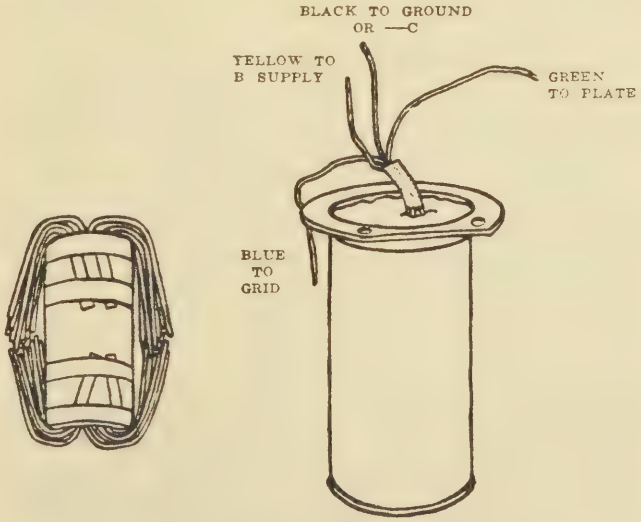


FIG. 6. AN ATWATER KENT AUDIO FREQUENCY TRANSFORMER (2d stage).

The iron core of a transformer builds up an electro-magnetic field which varies the same as the current in the windings. However, an iron core cannot respond efficiently to currents which vary at a rate of over 500,000 cycles per second, which is the case of radio frequency current, and radio frequency transformers are,

therefore, usually made without a solid core, and are termed "air-core" R. F. transformers.

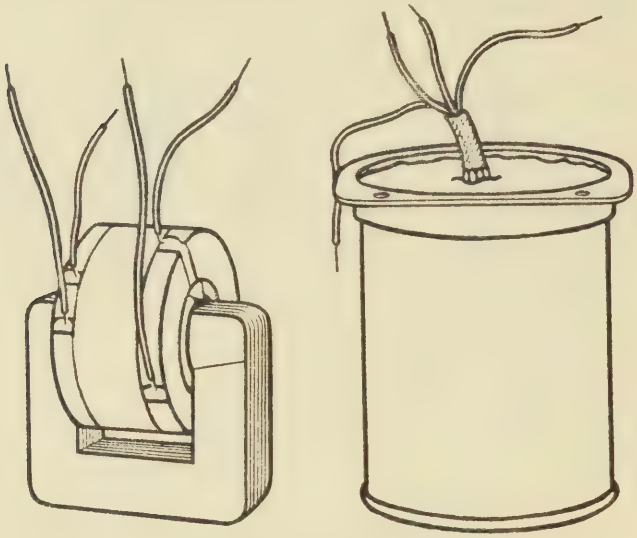


FIG. 7. ANOTHER TYPE OF ATWATER KENT AUDIO TRANSFORMER (1st stage).

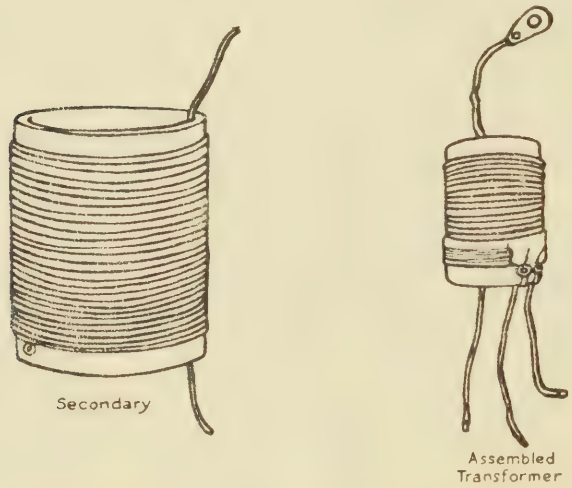


FIG. 8. TWO TYPES OF ATWATER KENT RADIO FREQUENCY TRANSFORMERS.

Fig. 8 shows the types of transformers used in our sets to amplify the radio frequency signals. As can be seen, these transformers do not have an iron core.

Radio Tubes—Construction

The radio tube is undoubtedly one of the most important units used in radio reception. We are all more or less familiar with the external appearance of common radio tubes, and in Fig. 9, we see how the tube is constructed internally. Most of the present-day tubes are vacuum tubes, but some of special type are filled with a rare gas which is chemically and electrically inactive. The filament of a vacuum tube is made of tungsten, thoriated tungsten or other metals coated with a chemical, which, when heated, emits electrons (negatively charged particles) in a vacuum. Tungsten, when it contains thorium, emits a greater number of electrons at a given temperature than plain tungsten, and consequently requires less current. The plate is made of thin metal,

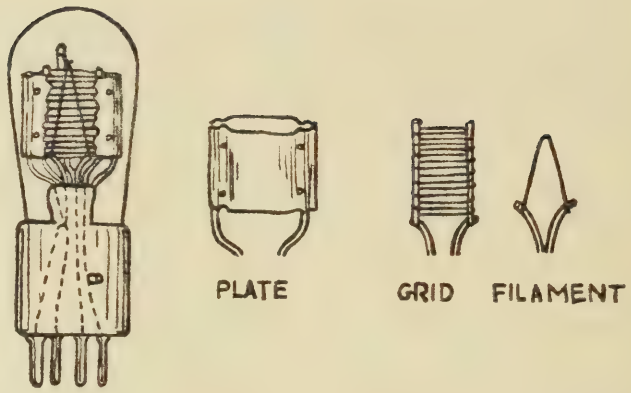


FIG. 9. CONSTRUCTION OF A TYPICAL RADIO TUBE.

stamped in the form shown in the illustration. The grid is of fine wire, so placed that it forms a sort of lattice work between the filament and the plate.

Internal Action of the Tube

The diagram on the right (Fig. 10) is a schematic symbol representing a vacuum tube. The diagram on

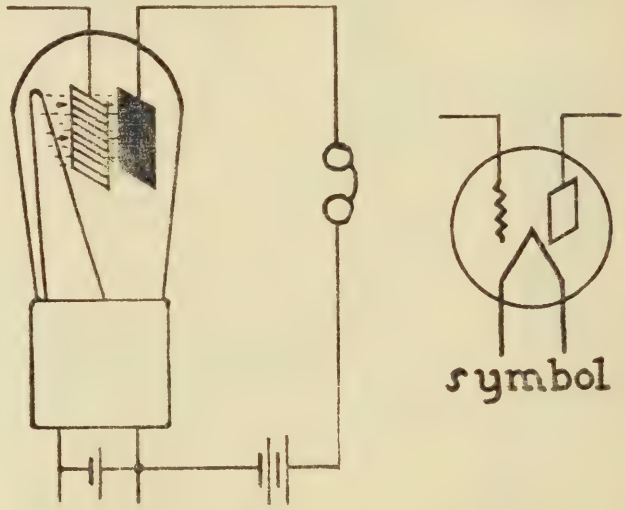


FIG 10. PATH OF FLO OF ELECTRONS IN VACUUM TUBE.

the left is also more or less schematic, so as to show more clearly just how the tube functions. The two ends of the filament wire are attached to the "A" or storage battery, which heats the wire so as to create the desired amount of electronic emission. These electrons would ordinarily fly off in all directions, but the plate of the tube being connected to the positive side of a "B" battery, has a high positive potential, and the electrons are attracted by, and flow to the plate. The grid is placed between the filament and the plate, and when the potential on the grid is comparatively positive it assists in causing the electrons to flow to the plate. When the grid is negative it repels the electrons on their way to the plate and when sufficiently negative, may stop the flow.

The negative side of the "B" batteries is connected to the filament and as mentioned before, the positive side is connected to the plate. In the particular illustration shown there is also a 'phone unit placed in the circuit. When a stream of electrons flows between the filament and plate, the "B" battery circuit is completed across this gap and a current passes through the 'phone unit. However, as previously stated, the potential on the grid

determines the intensity of the electron stream between the filament and plate, consequently as the potential on the grid varies, the current in the plate circuit and therefore in the 'phone unit also varies. The incoming broadcast signal is the factor which causes the potential of the grid to vary. Thus the current in the broadcast transmitter, varied by a voice or sound in a microphone at the broadcasting station and radiated in the form of high frequency alternating current, eventually controls the current which flows through the speaker unit at the receiving set and similar sounds are consequently reproduced. As a small voltage impressed on the grid controls a large current in the plate circuit, the tube may be used as a means of amplifying radio signals.

Action of Tube as Detector

The radio frequency currents which pass into the set from the antenna are of extremely high frequency, between 500,000 and 1,500,000 cycles per second. If a speaker unit were installed directly in this circuit with the current varying with such rapidity, it would be mechanically impossible for the diaphragm to respond to the variations in current. If it did respond, the pitch of the sound waves created would be so high that the sound would not be audible to the human ear.

It is, therefore, necessary to convert the radio frequency current to an audio frequency current which will operate a speaker unit and produce sound waves audible to the human ear. This is accomplished by the detector tube, which through the action of the grid condenser and grid leak, rectifies the radio frequency current. The potential on the grid of this tube is affected not only by the alternations of the radio frequency signal, but also by the charge which is stored up by the grid condenser. The current produced in the plate circuit of this tube has the same characteristics as the radio frequency current, but at a lower frequency.

Principles of Radio Wave Transmission

Some of the fundamentals of electricity and the units used in a radio set have now been discussed, and the question that arises in the minds of many is, "How does the radio frequency current generated by the broadcasting station reach the receiving set?"

Electrical energy in the form of a radio frequency wave which has been modulated by a voice or music, is radiated in all directions by the broadcasting antenna.

An analogous mechanical phenomenon will illustrate what takes place. When a tuning fork is made to vibrate, waves are sent out and any tuning fork within range having the same period of vibration will be affected and start to vibrate also. The tuning fork "A" (Fig. 11) is caused to vibrate by striking it, and the tuning fork "B," which has exactly the same period of vibration as the tuning fork "A," also starts to vibrate. The tuning fork "C," however, has a different period of vibration and is therefore not affected.

FIG. 11. TRANSFER OF MECHANICAL VIBRATIONS BETWEEN UNITS HAVING SAME FREQUENCY OF VIBRATION.

Purpose of the Antenna

A similar action takes place in the broadcasting and reception of radio. The radio frequency wave radiated by the broadcasting antenna sets up a corresponding radio frequency current in the antenna of a receiving set when it is tuned to the same frequency. The frequency of the wave is expressed in kilocycles or wave length, and since the tuning devices in the receiving set enable us to change the period of vibration or frequency of the set, we are able to receive waves from any broadcasting station within range. The radio frequency current in the broadcasting antenna is of such high frequency that a wave of electrical energy is radiated from it, and if the receiving antenna has the same period of vibration, it responds to this wave in such a way that a radio frequency current is set up in the antenna circuit. The purpose of the receiving antenna is therefore to convert the waves of electrical energy that are in the air to radio frequency current in the receiving set.

The alternating currents set up in the antenna circuit are of extremely high frequency, ranging between 500,000 and 1,500,000 cycles per second. As mentioned before, it is impossible to convert alternating current of such high frequency directly into sound waves, and it is therefore necessary to convert this current to a pulsating current of audio frequency. We have already explained how this is accomplished by the action of the detector tube.

Necessary Elements of Receiving Set

From the various points discussed so far, we can see that the simplest receiving set would consist of an antenna, to convert the electrical energy to radio frequency current; a tuning device, to bring the set to resonance with the desired wave; a detector, to convert the radio frequency current to an audio frequency current; and a 'phone unit to convert the audio frequency current to sound. It is highly desirable to amplify the signals received so that the sound waves produced will be of considerable strength.

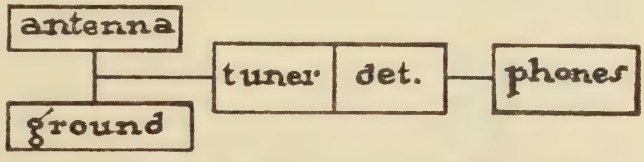


FIG. 12. FUNDAMENTAL UNITS OF A RECEIVING SET.

Circuit and Construction of Model 20 Compact Set

The Model 20 Compact three-dial receiving set has two stages of radio frequency amplification, a detector and two stages of audio frequency amplification. In

explaining what takes place in each stage, schematic diagrams will be referred to using the symbols shown in Fig. 13.

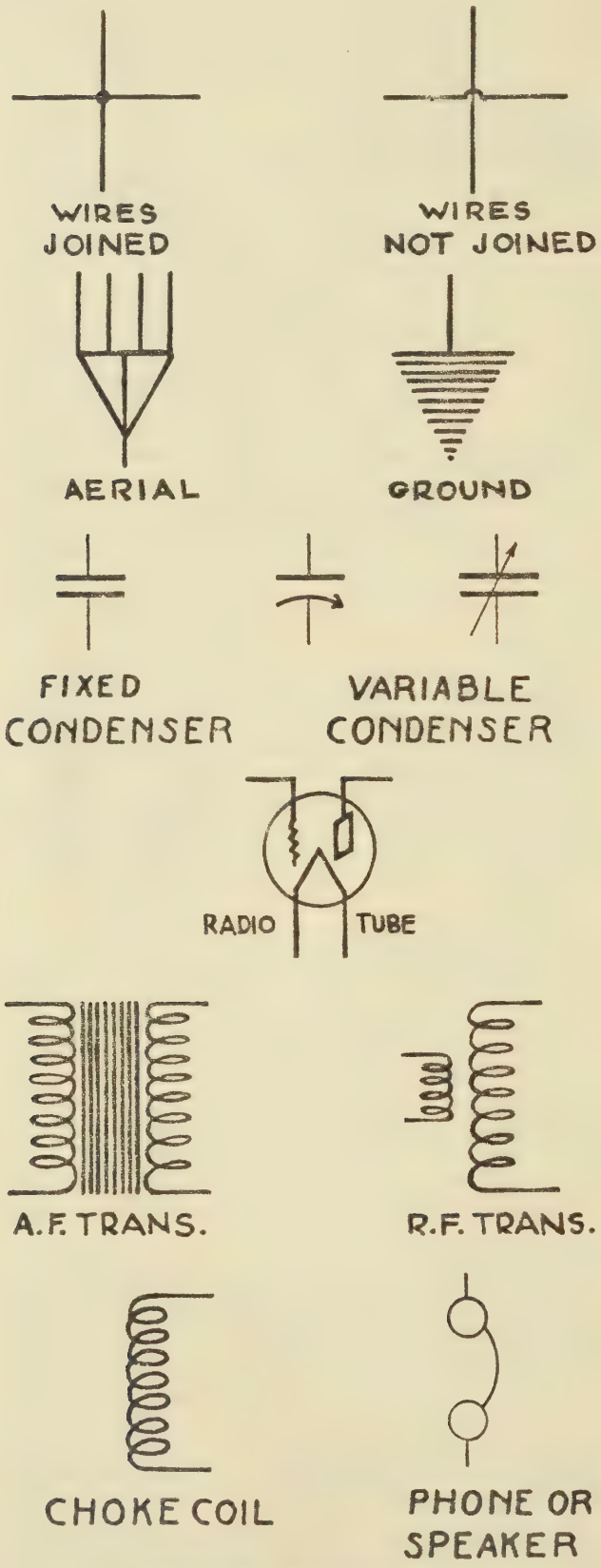
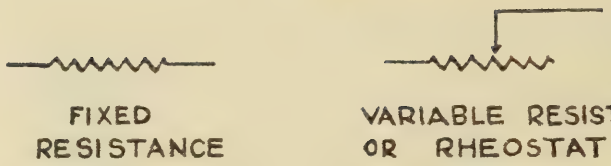


Fig. 13. Symbols Used in Schematic Radio Diagrams.



Referring to Fig. 14, the antenna circuit, which consists of aerial, primary of the first radio frequency transformer and ground, converts the waves of electrical energy in the air to radio frequency current. The aerial wire and the primary winding of the transformer give this circuit a certain amount of inductance. In general, and up to a certain limit, a long aerial and considerable inductance in the coil winding will pick up the greatest amount of energy. Too much inductance, however, lessens the selectivity and since it is impractical to shorten or lengthen the aerial wire to regulate this, we change the number of turns in the primary winding of the first coil by means of the tapped switch and thus accomplish the same thing. Placing the switch blade on the first tap (Fig. 14), puts fewer turns of wire in the circuit and increases the selectivity at a slight sacrifice in volume. Using the third tap, which uses all the turns of wire of the primary winding, increases the volume considerably, at a sacrifice of selectivity. The center tap is a medium between the first and third.

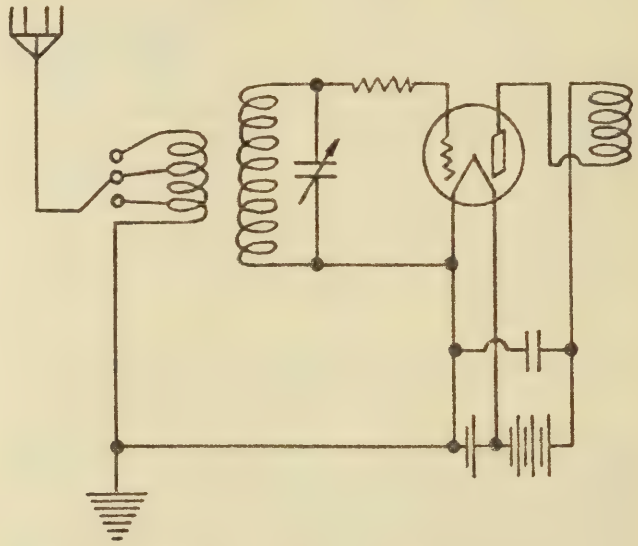


Fig. 14. Antenna Circuit and First Stage of R. F. Amplification—Model 20 Compact.

Detector Circuit—Action of Grid Leak and Condenser

After passing through the three radio frequency circuits, the signal which is still a radio frequency current as it was originally set up in the antenna circuit, but considerably amplified by the R. F. transformers, is impressed upon the grid of the detector tube (Fig. 15). The function of this tube as explained under tube action, is to rectify the radio frequency current to a pulsating current of audio frequency, and which has the same characteristics as the original current. This tube may be the same type as those used for amplifiers and the fact that it rectifies the current, instead of merely amplifying it, is due to the action of the grid condenser and grid leak. The grid condenser collects a charge and the

accumulated charge is impressed upon the grid of the tube. The grid leak prevents this charge from becoming too great by allowing it to leak off slowly to the filament circuit.

The grid leak is connected to either the positive or negative filament circuit, but experiments by our laboratory have shown that the detector circuit offers least resistance to weak signals when the grid leak is connected to a slightly negative potential. To accomplish this, a fixed resistance of about 450 ohms is installed directly across the positive and negative filament circuit, and the grid leak is connected to the two-fifths point, nearest the negative side.

The radio frequency current impressed on the grid of the detector tube is, by the above process, rectified to an audio frequency current in the plate circuit of this tube,

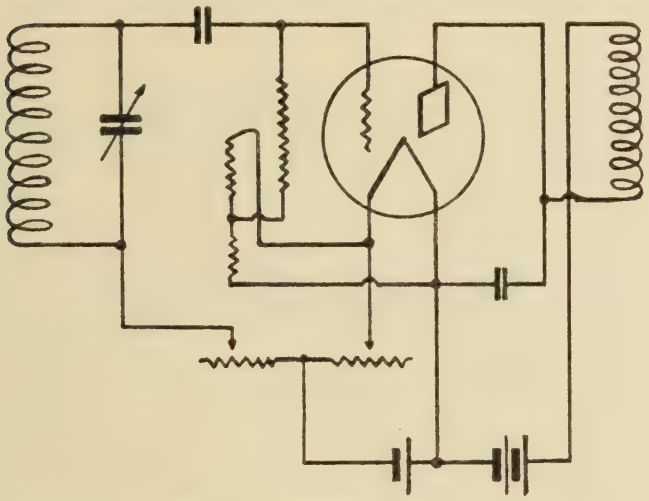


FIG. 15. DETECTOR CIRCUIT.

and if a 'phone unit were connected in series with this circuit, the broadcast signal would be converted to sound. However, for purposes of loud-speaker reproduction, it is desirable to amplify this signal to greater strength, and accordingly the primary winding of an audio frequency transformer is placed in this circuit instead. This plate circuit is completed through the "B" battery to the filament circuit.

Purpose of "'Phone Condenser"

There is a small component of radio frequency current which is passed to the plate circuit of the detector tube from the grid circuit. If this current were allowed to pass through the "B" batteries and audio transformer with the audio frequency current, it would cause some distortion. A small fixed condenser called a 'phone condenser is therefore connected between the plate and the filament of the detector, which shunts this radio frequency current across the audio transformer and "B" batteries. No direct current from the batteries and none of the audio frequency current can go through this condenser.

Action of Audio Frequency Transformers

The pulsating current in the primary circuit is induced and amplified in the secondary circuit and is again impressed upon the grid of the next tube (Fig 16). It is amplified to the plate circuit of this tube, in which circuit is placed the primary of the second audio frequency transformer. The signal is then induced and amplified in the secondary of this transformer and is again sent into the grid circuit of the next and last tube. The sound unit of the radio speaker is installed in the

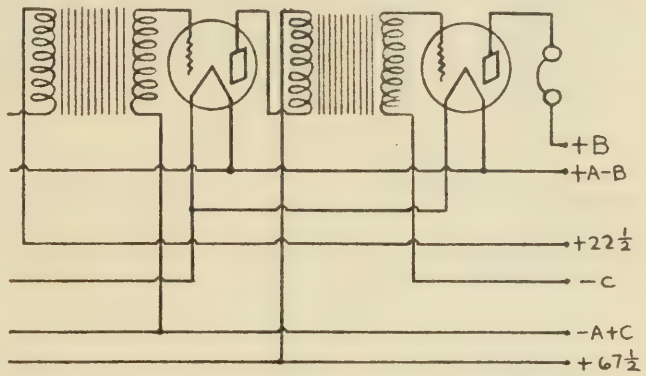


FIG. 16. AUDIO FREQUENCY CIRCUIT.

output or plate circuit of this second audio frequency amplifier tube, and the variations in current cause the diaphragm to vibrate and send out sound waves which have the same characteristics as the wave of the pulsating current sent through the sound unit. The characteristics of this electrical current were determined by the sounds sent into the microphone at the broadcasting station. The theory and construction of speaker units is described in Section X of this Manual.

Use of "C" Battery

One lead from the secondary of the first audio transformer is connected to the grid of the following tube and the other lead, called the grid return, is connected to the filament of the same tube. The grid return of the second audio transformer, however, is connected to the filament of the last tube through a "C" battery, this grid return being connected to the negative side of the battery. As explained under tube action, the potential on the grid of the tube determines the flow of "B" battery current across the plate and filament, the flow being less when the grid is comparatively negative. By placing a negative potential supplied by the "C" battery on the grid, considerable "B" battery current is saved, and amplification without distortion obtained.

Power Tubes

Power tubes are tubes especially designed to handle the considerable volume of signal reaching the last stage of audio amplification and at the same time give improved tone quality. They require additional "B" battery voltage on the plate, and also a fairly high negative voltage on the grid, to prevent the tube from becoming overloaded, which would cause distortion. The "C" battery is connected so as to operate on the last tube only, so that the desired negative voltage may be used on the grid of this tube without affecting the first audio tube, which would not function properly if used with the negative grid voltage required by a power tube.

Grid Resistances and By-pass Condenser

Two units which have not as yet been discussed and which are essential to the operation of the set are the

grid resistance unit and by-pass condenser. A grid resistance is connected in the grid circuit of each of the radio frequency amplifier tubes and is one of the means used to keep these tubes stabilized.

The by-pass condenser is shunted across the "B" power supply of the radio frequency tubes and allows the plate circuits of these tubes to be completed directly to the negative filament circuit. This likewise assists in stabilizing the set and preventing distortion.

Filament Connection of Tubes

There are two fundamental methods of connecting several electrical units in the same circuit, namely **series** and **parallel** (see Fig. 17). Each method has its own particular advantages and is used accordingly. In the case of a parallel connection of units, each unit can receive the voltage of the source of current and can be operated and controlled independently of the others. For this reason the tubes in our sets, in fact in most radio sets, are connected in parallel (see Fig. 19).

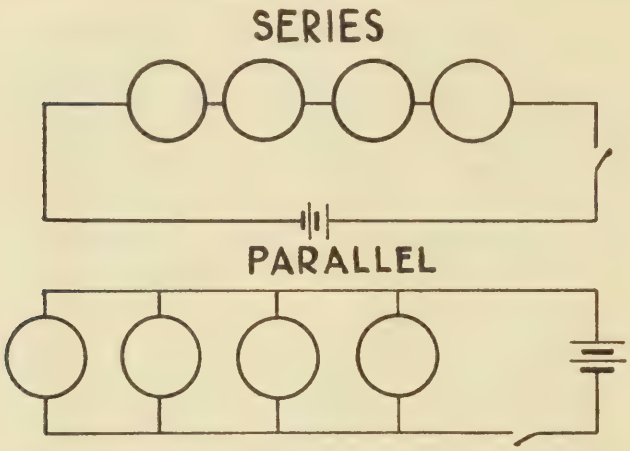


Fig. 17. The Two Fundamental Methods of Connecting Several Electrical Units Together.

Arrangement of Rheostats

A variable resistance, or rheostat, is connected in series with one of the main filament battery leads to the radio frequency tubes, which permits the control of the filament current supplied to these tubes independently of the other tubes. Another rheostat is connected in series with the detector tube to control it separately.

The audio frequency tubes require a definite voltage to operate at maximum volume. A lower voltage will reduce the volume, but while this is sometimes desirable, it also impairs the tone quality. A higher voltage does not improve the tone or the volume and our sets are therefore equipped with a fixed resistance rather than a rheostat for these audio tubes. The volume of the set is readily controlled by the radio frequency rheostat.

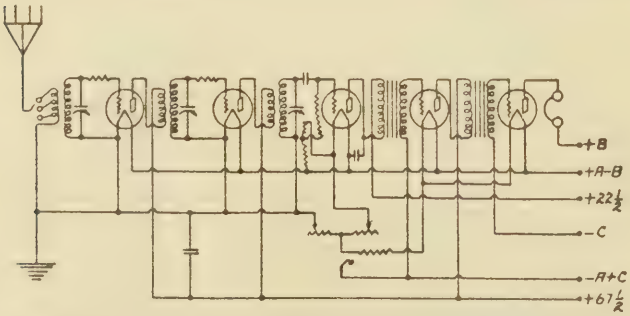


Fig. 18. Schematic Wiring Diagram of Model 20 Compact Set.

Plate Voltage on Different Tubes

The plate of each tube is connected through the primary of the transformer following it, to the positive side of the "B" batteries. Tubes functioning in different circuits of the set required different plate voltages and the plates are therefore connected to different terminals of the source of "B" voltage (batteries or "B" power unit). The plates of the radio frequency tubes and the first audio tube are connected to positive 67½ volts, the detector to 22½ volts, and the last audio tube to plus 90 or a higher voltage, according to the type of tube used.

Model 30—Circuit and Operation

The general circuit of the Model 30 set (Fig 19) is very similar to that of the Model 20 Compact No. 7960,

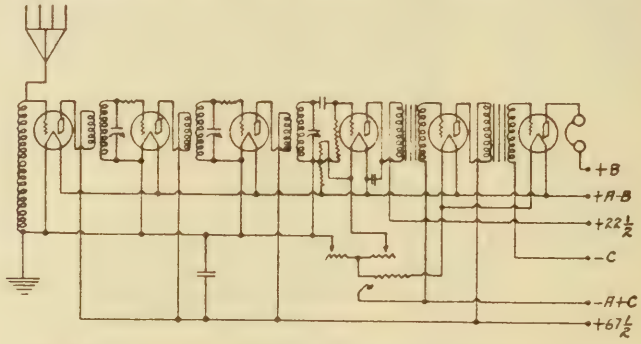


Fig. 19. Schematic Wiring Diagram of Model 30 Set.

but being operated by one dial, certain additions are necessary. The radio frequency transformers are substantially the same as those in the three-dial sets and have approximately the same inductance. However, these transformers are not taken indiscriminately and installed on sets, but each set of coils is selected after their inductances and other characteristics have been determined by special apparatus. A set of variable condensers is likewise carefully selected to be used with these transformers.

"Synchronizing" the Condensers

The variable condensers are controlled simultaneously by having the rotor shafts driven by belts, which are connected to a common pulley, which is turned by the single or center dial (Fig. 20). As the dial is turned, the capacities of the three variable condensers are changed uniformly, and the respective circuits which they tune are all brought into resonance with the same frequency of current. Because these condensers and transformers have all been accurately matched, this condition holds good over the entire wave length band.

Condensers, so adjusted that one movement will tune all their circuits, are termed "synchronized." The method used in the Atwater Kent single-dial sets is licensed under Hogan Patent Number 1014002.

On the three-dial sets it was observed that as the condensers were tuned for various wave-lengths, the dial settings of the three condensers were approximately the same. By the system of matching already explained, the slight difference in setting is overcome, and synchronism is established.

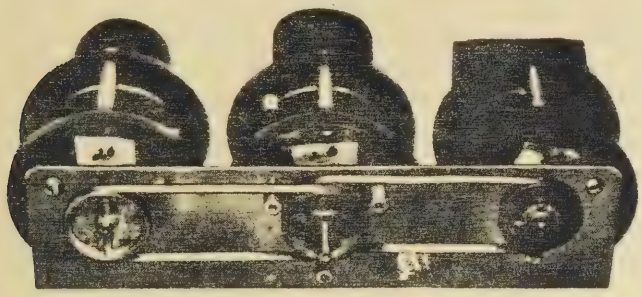


FIG. 20. METHOD OF CONNECTING VARIABLE CONDENSERS BY BELTS.

Eliminating the Antenna Tuning Device

It was also observed in the case of the three-dial receivers that the setting of the first dial varied according to the length of the aerial used, while the other two dial settings were unaffected. Since we cannot tune the aerial circuit independently in a one-dial receiver, we must overcome this condition in some other way. An additional tube, which is installed in the antenna circuit, takes care of this.

This tube has very little value in amplifying the signals, being used simply to transfer all signals from the antenna circuit to a position where any desired one can be selected and amplified to maximum by the synchronized tuning control before it reaches the detector. It also eliminates the effect of the antenna circuit on the tuning of the succeeding circuits by the dial.

Model 35

The Model 35 set is considerably different from the Model 30 in the mechanical design, which requires certain changes in the electrical design. The circuit, however, is identical with that of the Model 30, with the exception of the detector rheostat. (Fig. 21.) In the other sets, the radio frequency tubes are controlled by one rheostat, the detector tube by another, and the audio exception of the detector rheostat. (Fig. 21.) In the set, the radio frequency tubes are controlled by a rheostat, and the detector and audio frequency tubes are controlled by a fixed resistance.

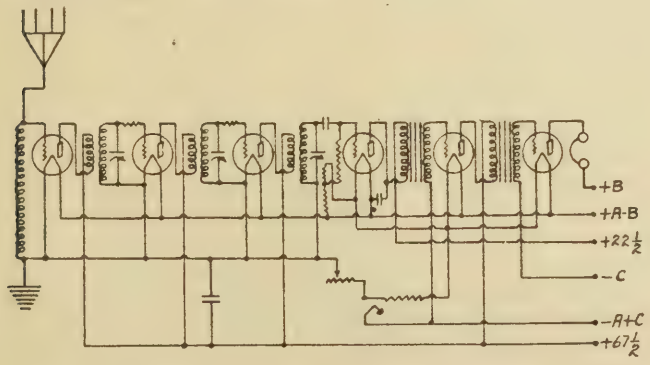


FIG. 21. SCHEMATIC WIRING DIAGRAM OF MODEL 35 SET.

Model 32

The Model 32 set has an additional stage of radio frequency amplification which necessitates a fundamental change in the type of radio frequency transformer used. In the Model 20, 30 and 35 sets, which have three radio frequency transformers, the transformers are mounted at right angles to each other, to prevent an electrical coupling between them. However, the Model 32 set has an additional radio frequency transformer, and since there are only three mutually perpendicular planes, we must use a different method to prevent a coupling between these transformers.

The circuit and functioning of this set is identical with that discussed for the Model 30, except for the additional stage of radio frequency amplification, which requires an additional transformer, tube socket and variable condenser. This stage of R. F. amplification increases the selectivity, sensitivity and volume of the set. The extra condenser is tuned by a third belt, also connected with the main or single control dial shaft. There are therefore three belts controlled by the tuning dial of the Model 32.

Model 33

The Model 33 set is a six-tube outfit, combining some features of both the Model 20 Compact and the Model 30 sets. It has three stages of radio frequency amplification, controlled by a single dial similar to the Model 30. However, instead of the untuned antenna circuit, an inductance or antenna coil is connected between the antenna and ground and provided with two taps connected to binding posts, so that part or all of the coil can be placed in the circuit, depending on the length of the antenna used. In addition to this, one of the rotary plates of the first variable condenser is controlled by a separate small knob at the left side of the panel, so that perfect resonance is obtainable in the antenna circuit regardless of the length of antenna. This set is therefore more selective than the Model 30, and easier to tune than the Model 20 Compact, at the same time being more efficient than either. A schematic diagram of the Model 33 will be found in Section VI of this Manual.

A.C. Type Receivers

During the summer of 1927 a new type of tube was developed, the outstanding characteristic of which was the fact that it was designed to operate with alternating current on the filament instead of direct. The producing of these tubes meant that it was possible to design a set to operate direct from the A. C. electric socket without batteries, since the only necessary step was to reduce the voltage of the A. C. line to the correct value for the tube filaments, which is easily accomplished by means of a "step-down" transformer. The B voltage requirements of these tubes being practically the same as those of the previous type D. C. tubes, the incorporation of a B power unit in the set along with the step-down transformer results in a completely light-socket-operated set.

The theory of function of the A. C. tubes is very similar to that of the D. C. tubes, and will not be discussed here. In general performance they compare very favorably with the D. C. tubes. The filament voltage requirements are slightly different, however, an A. C. voltage of 1½ being required for the amplifier tubes and 2½ volts for the detector tube. The power tube used is a regular D. C. type requiring the standard 5 volts, since by the use of a center-tapped resistance across its filament terminals, the effect of the A. C. fluctuations is effectively balanced out in this particular circuit.

The A. C. detector tube differs from the D. C. tubes in having an extra element known as the "cathode." This necessitates a five-prong socket for this tube. The cathode is a cylinder of special metal surrounding the filament, and performs the same function as the filament in a D. C. tube. The filament in the A. C. tube is used only to warm the cathode so it can function. Owing to the material and construction of the cathode, a period of about 30 seconds after the set is turned on, is required before it warms sufficiently to function and allow signals to come through the set.

Power Units In the A.C. Receivers

The power units used in Atwater Kent A. C. receiving sets furnish direct current "B" supply for the plate circuits, direct current "C" supply for the grid circuits, and alternating current of the proper values for the filaments of the A. C. tubes. Every power unit consists of the following essential parts:

(1) **A power transformer** to change the voltage of the 110 volt A. C. line to the required higher and lower values. This transformer has a primary, a high-voltage center-tapped secondary winding, a low voltage secondary winding for the filament supply of the rectifier tube, and three other low voltage secondary windings for the filament supply of the receiving tubes.

(2) **A double-wave filament-type rectifying tube** that converts the high voltage A. C. to pulsating D. C. The tube has two separate plate electrodes which are connected to opposite ends of the high-voltage winding. The center tap of this winding is connected to ground, which is equivalent to —B. When the outside circuit between the filament of the rectifying tube (equivalent to +B) and the center tap of the high voltage winding is completed through the filter and the plate circuits of the radio set, electrons flow from the filament to whichever plate is positive. As the rectifier plates are alternatively positive, electrons flow from the filament almost continually. This flow of electrons constitutes a steady flow of pulsating direct current.

(3) **A filter section** consisting of audio frequency chokes and high-capacity fixed condensers, serving to smooth out the pulsating direct current delivered by the rectifying tube and make it pure and noiseless in action.

(4) **Resistances** of the correct value to reduce the high rectified voltage to the values required by the first A. F. and detector plate circuits. By-pass condensers are connected to these resistances.

(5) **A grid bias resistance** connected between the ground and the second A. F. filament circuit, and another bias resistance connected between the ground and the R. F.—first A. F. filament circuit. The plate currents flow through these resistances and cause a voltage drop across them, the filament end of each resistance being positive with respect to the ground end. By connecting the grid return leads of the amplifying tubes to ground, the grids are maintained at a negative voltage with respect to the filaments.

(6) **Three separate "step-down" filament windings** or secondaries on the power transformer. These reduce the 110 volt A. C. supply to the voltages required by the filaments of the tubes, about 1½ volts for the R. F. and first A. F. filaments, 2½ volts for the detector filament, and about 5 volts for the second A. F. filament.

Connections between the filament circuits and the set are made to a center tap on resistances of low value shunted across each filament supply winding. The purpose of these center-tapped resistances is to provide a neutral voltage point which does not vary in value. The voltage on either side of the filaments is alternating (A. C.), and if the grid-return leads were connected to either side of the filament circuits, this A. C. voltage would be impressed on the grids of the tubes, causing a loud hum in reception. The center tap on each shunt filament resistance is like the pivotal or center point on a see-saw, it does not move up or down, but remains steady.

(7) **A speaker or output choke.** One end of this choke is connected to the rectified and filtered high voltage supply and the other end is connected (through the set cable) to the plate of the second A. F. tube. The choke offers but little resistance to direct current, but it has a high effective resistance or impedance to audio frequency variations, tending to make audio frequency variations of the plate current flow through the speaker, which is coupled to the plate of the second A. F. tube through a fixed condenser (the speaker filter condenser). The return lead from the speaker is connected to the center tap of the second A. F. filament shunt resistance. With this arrangement no direct current flows through the speaker, but only the audio frequency or A. C. component of the plate current.

(8) **A panel assembly** which contains the terminals for connection to the cable card of the receiving set. On all power units except that used with the early Model 36 sets, the grid biasing resistance and the plate circuit and filament shunt resistances also are mounted on this panel.

(9) **A line voltage regulating resistance** is used on some of the recent models. This resistance is connected in series with one side of the 110 volt supply line, and it serves to maintain a constant voltage across the primary of the power transformer, automatically compensating for line voltage variations and fluctuations. The resistance of this regulator increases if the line voltage increases above normal, and the resistance decreases if the line voltage goes below normal. This device is mounted on the left-hand side of the power unit container.

SECTION II

PLANNING THE SERVICE DEPARTMENT

1. The Service Room

The first thought of the dealer, once he has been "sold on the idea" of rendering real service, will be a suitable workshop or service room in which to carry on this work, and also the tools and equipment he will require to perform radio service completely and efficiently.

In most cases it will be necessary for the dealer to utilize for his service room whatever location may be available for this purpose under the conditions of his present floor layout, but where there is a choice, or in case of the occupying of new quarters where any desired layout can be planned, it is suggested that the service and parts stock room be arranged adjoining or convenient to the rear of the sales and display room. With this arrangement, customers bringing sets in for service can be referred promptly to the "Service Department," which will avoid unnecessary delay and confliction with the work of the floor salesmen. The dealer's "outside service man" can, of course, enter the shop by the rear entrance.

The service room need not be large, but should be well lighted. If possible to have outside light directly on the service bench or table from one side or the rear, it will enable the service man to work in greater comfort and consequently to produce more efficient results.

2. The Repair Bench

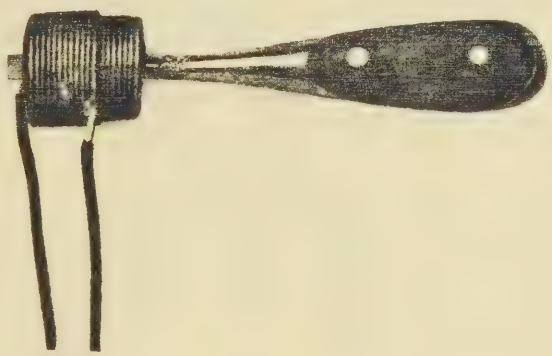
The service bench or "repair table" should be four or five feet long and about twenty inches deep. The height should be about thirty-six inches, so as to permit the repairman to work at it conveniently while standing. The top of the table should be of fairly heavy pine wood, and the legs should be heavy enough to insure the bench being absolutely firm and free from vibration. One or two round-topped stools can be provided for the men when working on jobs requiring some considerable time.

3. Suggestions for Service Equipment

A reasonably complete outfit of meters and tools, which will cover the making of any ordinary tests and repairs, is suggested as an initial equipment for the dealer's service room, and consists of the following:

Voltmeter for testing circuits, 0-50 Volts D. C.
Thermo-galvanometer for "test stand," 0-100 scale.
High resistance triple range voltmeter 0-200 Volts D. C., 1,000 ohms per volt.
D. C. Ammeter, 0-5 Amps. D. C.
A. C. Voltmeter, 0-5 volts.
A. C. line-voltage meter 0-150 volts.
Milliammeter 0-100 M. A.
Tube testing device.
Hydrometer.
Soldering iron and equipment.
Testing prongs with cables (several pair).
Set of small open-end hex. wrenches.
Set of small socket type hex. wrenches.
Assortment of screw drivers, pliers and wire cutters.
Assortment of spring type clips for quick connections.
Assortment of small fuses (1 and 2 Amp. and 100 M. A.).
Pair of special wrenches for removing cone of E speaker (Part No. 9255).
Open end wrench for toggle switch (for 5/8-inch hex. nut).

Note: A magnetized screw driver is of great assistance in removing and inserting screws in places which are ordinarily difficult to get at, and it is suggested the dealer keep one handy. To magnetize a screw driver, simply insert the blade inside a coil about 50 turns of No. 18 or other insulated wire, the terminals of which are connected to a 6 volt battery (see illustration No. 22) and close the circuit for a moment.



TO 6-VOLT BATTERY

FIG. 22. MAGNETIZING A SCREW DRIVER.

4. Arranging the Equipment

All tools frequently used should be kept in a definite place where they will be accessible without delay. A row of hooks at one end of the work table or on the wall handy can be recommended for this.

It is suggested that the testing meters listed in paragraph 3, with the exception of the galvanometer, low range ammeter and A. C. line voltage meter, be mounted in a row on a wooden or bakelite panel extended up vertically from the rear of top of test table.

Two flexible leads should be attached to the terminals of each meter, these leads being of sufficient length to reach practically to either end of the test table and fitted with testing prongs at the lower terminals. A small single-throw knife switch, mounted just below the meter, had best be inserted in series with one lead from each meter, and a 45 volt dry B battery should be included in series with the 0-50 D. C. voltmeter for continuity tests of circuits. The switches should be left open when the meters are not in use.

The other three meters are used in connection with the "Test-Stand" and their use will be described later on.

5. Locating Repair Parts Stock and Repair Material

The best method of arranging the stock of repair parts is to keep them in rows of small wooden bins or in glass jars on sets of shelves on the wall. Each bin or jar should be carefully labeled with the part number and name.

It will also be advisable to have an additional set of shelves for complete sets and speakers—for example a shelf for jobs "to be repaired," one for sets "ready for delivery," and one for sets "awaiting instructions" from the owner or waiting for parts which have been ordered.

6. Equipment for the Outside Service Man

The amount and type of equipment provided for the dealer's "outside service man" will depend on the total investment being made in service equipment, and the ability of the outside man in using meters, etc., to locate and perhaps repair minor troubles in the customer's home.

As a rule it is preferable to make only the external tests in the customer's home, and if trouble is found to be within the set or speaker they can be loaded into the service truck and brought to the shop. This avoids the bad psychological effect of making an actual set repair in the presence of the owner.

There are several complete set testing outfits on the market made by reliable companies such as Jewell, Weston, etc., ranging in price from $50.00 to $200.00 or more (retail price). These include all necessary voltmeters, ammeters, tube testers and, in some cases, an oscillator for making reception available when there is no broadcasting.

If the dealer does not feel able to invest in one of these outfits, the following set of articles is suggested. Additions can be made as found advisable:

Soldering iron.
Screw drivers, several sizes.
Wrenches, hex., several sizes.
Combination pliers and wire cutters.
Hydrometer.
Voltmeter (preferably high resistance type).
Tubes—One or two of each type.
Headphones or speaker.

The above equipment will provide for checking all batteries, tubes and the speaker, as well as the output voltage of a B Power Unit. Any troubles outside the set can thereby be immediately detected and if the difficulty is traced down to the set it can be disconnected and brought to the service shop for the usual routine circuit and voltage tests, and necessary repairs.

7. Keeping Records on Service

This feature is one which the dealer cannot afford to neglect if a smooth-running Service Department is to be maintained, and if the avoidance of misunderstandings with the customer and unnecessary correspondence with the distributor is desired.

Pads of printed forms, serially numbered and with sufficient copies for office records and the customer, should be used for handling repair jobs, and the date on which a set is brought in for repair, date repair is made, and also delivery date with customer's signature obtained, should be carefully entered. The serial and model numbers of the set must always be noted in order to avoid question as to whether the repair is a warranty job.

If a repair "invoice" is made out separately, the number of the repair tag and all other data should be placed on the invoice.

All expenditures in the line of service should be recorded carefully in a book, so that at the end of the year a comparison can be made between the cost of maintenance of the department and the total income from repair work done. The latter will, of course, be made up of the profit in repair parts and the amount charged out for labor on repair work.

We also recommend the keeping of a careful "inventory" of the stock of repair parts. A "perpetual inventory" is the best if care is taken to keep it up to date. A record card should be maintained for each item kept in stock, and the quantity of this item and date received from the distributor recorded, as well as the date and repair number whenever one is used on a repair job. By going over the stock once a month or so, and checking the inventory, any items on which the stock is getting low can be ordered from the distributor and thus an adequate stock of all parts may be kept on hand at all times.

It is also a good plan to keep a complete "service record" of every new set sold, the date of each service call made being noted, together with the adjustments or repairs required. The service expense (or profit) on each set sold can therefore, be determined at a glance.

Some dealers find it well to establish a form of "service contract" with the customer, whereby free service is provided within a certain period, and a nominal charge made thereafter. A printed form signed by both dealer and customer with a duplicate copy for the customer, is necessary for this purpose. A similar "service contract" plan could be arranged equally well for any customer desiring to obtain service for his set on the contract plan, a slightly different form being required in such cases. Such contracts usually cover a year's time and provide for a limited number of service calls at a certain cost, an extra charge being made for additional calls.

8. Service Personnel—the Psychology of Service

In the selection of a man or men to handle the Service Department of his store, the dealer should consider three main factors:

1—Education and experience.
2—Natural ability on radio repair work.
3—Ability to meet the customer.

It is self-evident that to perform satisfactory work as a radio service man, experience along radio lines and ability along the lines of electrical and mechanical repair

work are essential. The third factor, however, is not usually given due consideration, in fact too often it is sadly overlooked.

The Service Department, rather than being looked upon as a necessary evil (as it was several years ago before the dealer had been educated to its true value), is now considered one of the biggest factors for building good-will and indirectly increasing sales that the dealer can possibly have. But this is not possible unless the service man takes the proper attitude toward the customers and his own work. He should always assume the attitude that "the customer is right." He should listen politely to his story of his trouble and endeavor to assure him cheerfully and convincingly that his difficulty will soon be a thing of the past. Confidence in the product and in his own ability will be a powerful factor in the service man's favor in this connection. He should never argue with a customer and never make promises he cannot fulfill. All appointments made should be kept without fail.

All in all, a proper understanding of the psychology of service on the part of the service man will help to make the Service Department a still greater asset to the eventual success of the radio dealer's business.

FIG. 23. TWO VIEWS OF A WELL-LAID-OUT SERVICE ROOM.

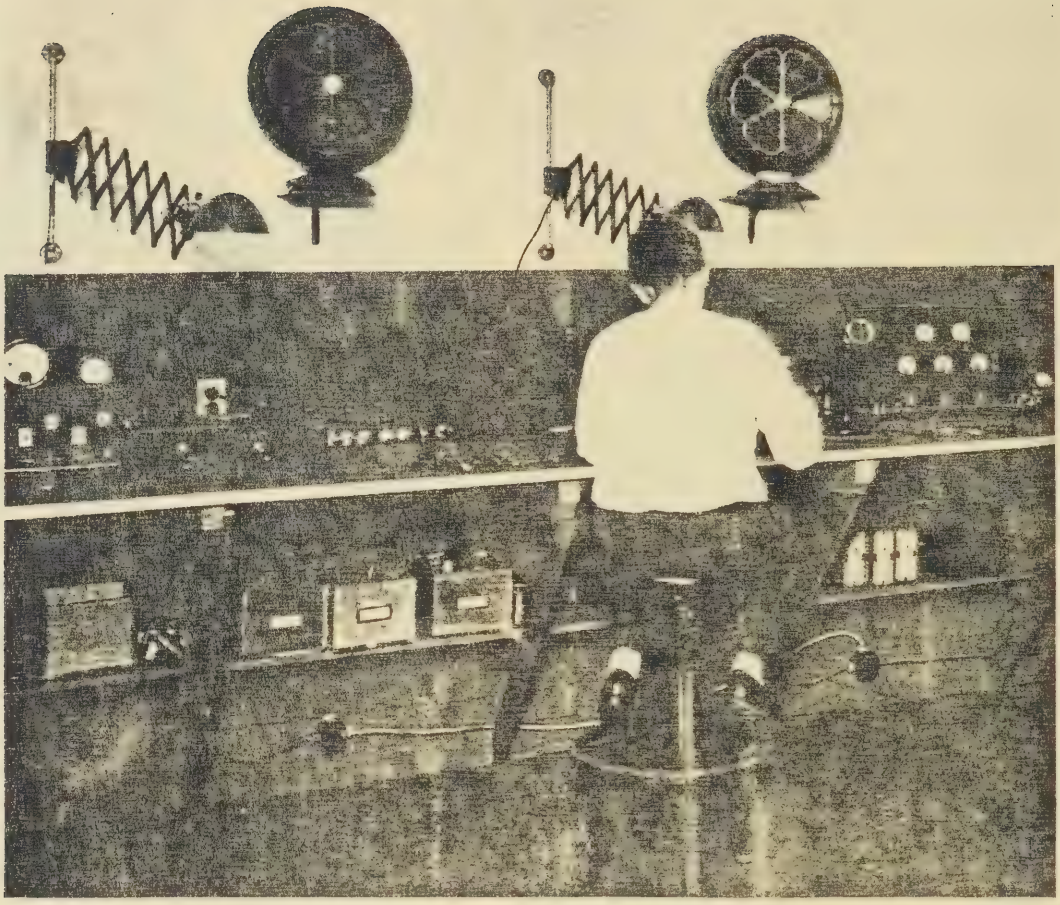


Fig. 21. Another Well-Arranged Service Department.

SECTION III

USING THE SERVICE EQUIPMENT

1. Continuity Testing with Voltmeter

One of the most important as well as the quickest and simplest methods of locating trouble in a set, is by testing the "continuity" of the various circuits, that is checking to see if the circuit is complete. This is done by means of the low range D. C. voltmeter, the type suggested in our "List of Equipment" being a meter reading from 0-50 volts. This is connected in series with a 45 volt dry B battery, and the terminals of this hook-up are fitted with test prongs which can readily be applied to any two points on a set.

Where the resistance of the circuit being tested is low, the meter should read practically the full voltage of the battery. In testing through the windings of a transformer or resistance unit, however, there will be a corresponding drop in voltage, and when testing across a condenser, which is, of course, an insulator for D. C. (direct current), no reading should be obtained. If the results experienced on a certain test vary from the above general outline, trouble in the circuit or unit being tested is indicated.

A complete set of continuity test charts for the circuits of our sets is contained in Section VI of this Manual.

2. Voltage and Current Tests during Operation

(a) Advantage of Voltage Tests

It is frequently desirable to test the actual voltages being delivered to the various circuits of the set by the power supply, while the set is under actual operating conditions. It is obvious that any factor which would cause the applied voltage to vary much from the correct value required by the tubes and the design of the set, would result in improper functioning and possibly damage to the set or tubes. Consequently, if incorrect voltage supply is suspected as the cause of an ailment it is well to make an immediate check with the proper instruments.

For testing both the A and B voltage of battery type sets, and the B voltage on A. C. sets, a high resistance volt-meter should be used. The best type is one having several ranges such as 0-10, 0-100 and 0-200, any one of which can be used by changing connections on the meter.

(b) Testing Filament Voltage—Battery Type Sets.

The low range 0-10 terminals are used when testing the A voltage delivered to the set, this voltage being obtained by applying test prongs from meter to the

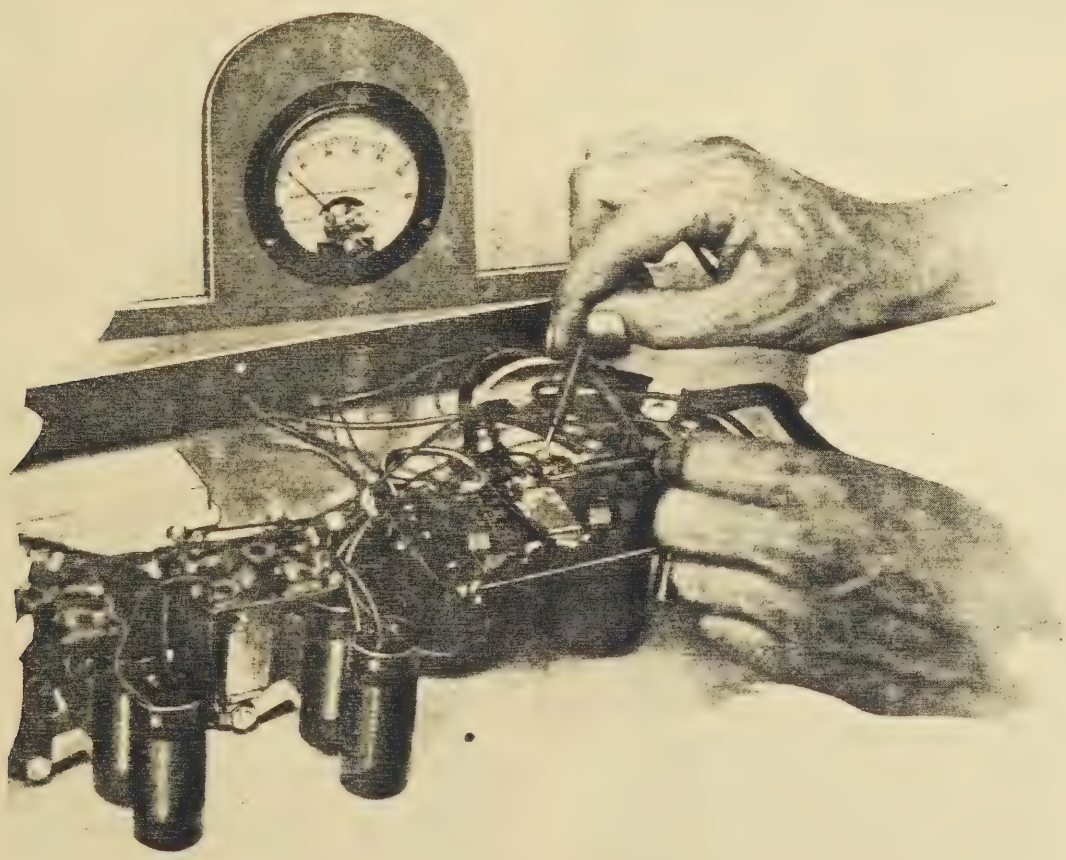


FIG. 25. TESTING CIRCUIT CONTINUITY WITH VOLTMETER.

"minus A" and "plus A" cable terminals of the set—or if the voltage on a particular tube is desired, the test prongs can be applied directly to the socket fingers (+F and —F) of that tube, assuming the set has been removed from the cabinet for testing purposes.

(c) Checking Plate or B Voltage

The high range terminals of the voltmeter are used for measuring the B voltage delivered to the tubes, either at the terminals of the B Power Unit, B batteries (or power unit in the A. C. sets), or across the tube socket plate "P" contact (corresponding to plus B) and the filament cable terminal. For example, to measure the plate or B voltage on the R. F. tubes, the test prongs should be applied to the white and either the red or black cable terminals of set, or for a particular R. F. tube one prong to contact "P" of that tube socket and the other to either one of the filament contacts of the same tube.

The intermediate range terminals on the meter can be used for measuring such voltages as the detector B voltage or the C voltage on a 171 type power tube.

(d) Filament Voltage—A. C. Sets

For testing the "A" or filament voltage on the tubes in A. C. sets, the low range A. C. voltmeter is used. It should be noted that the detector, amplifier, and power tubes in these sets receive different A voltages respectively. Each voltage is tested by applying the test prongs from this voltmeter to the proper corresponding pair of filament circuit terminals on the power unit (where connection is made from set to power unit), or at the tube socket contacts if the reading for a certain tube is desired. Individual voltage readings on each 226 tube can be taken without removing set from cabinet by inserting test prongs in eyelets at edge of socket, located over filament contact springs.

A complete voltage table for all sets will be found at the end of Section VI.

(e) "C" or Bias Voltage—A. C. Sets

This can be easily checked with the high resistance D. C. voltmeter, using the medium range scale for the last audio tube, and the low range for the first audio tube. Insert testing prongs into eyelets of tube socket corresponding to the grid and filament contact fingers.

(f) Milliammeter—Checking Plate Current

This instrument is chiefly used to check the amount of plate current being drawn by a tube or group of tubes in order to determine if it is normal. For example, an excessive plate current consumption by the R. F. tubes may indicate a leaky R. F. by-pass condenser, while an abnormal plate current being drawn by a power tube may indicate incorrect "C" or bias voltage. (It is assumed, of course, that the tubes themselves have been checked.)

To use this meter, place the test prongs from it in series with the particular plate circuit to be tested. The easiest way to do this is to disconnect the cable wire supplying that circuit at its lower terminal (at the source of power) then connect one meter test terminal to the end of cable thus released and the other to the post from which it was removed. Where there are several tubes in parallel on the same plate voltage supply, a test of the plate circuit on one of them will require opening the plate circuit of that tube near the plate contact of socket and applying the testing terminals to the ends of the circuit thus opened.

(g) Testing Grid Leaks

The best way of testing a grid leak is by means of a special and rather expensive device known as a "megger." As it would hardly be economical for the dealer to purchase one of these, we suggest the following test. Connect the set up for receiving, tune in a loud broadcasting signal and place the hands on first and last R. F. transformers. This should stop the reception almost entirely. Upon removing hands from the transformers, the signal should return instantly. If it hesitates for just a second or more, this is an indication of a poor grid leak, and a replacement should accordingly be made.

3. Testing Repaired Sets—Output Measurement

The simplest method of testing a set which has been repaired is, of course, to try it out on broadcast reception, judging the volume by ear. This method, however, is not very accurate, and as broadcasting is not always available and it is usually desirable to test reception on several wave lengths, an outfit consisting of a device capable of producing a signal on any of several definite wave lengths, and a "galvanometer test stand" for comparative measurement of volume of reception, is recommended. As a matter of fact such an outfit is now standard equipment in practically every modern radio service shop.

(a) Signal-Producing Apparatus

There are several forms of set-up which can be used for producing a steady signal in a radio receiver for testing purposes, and it is not our policy to recommend any particular type here.

The best plan for the dealer who desires to purchase or build one of these outfits is to communicate with his territorial distributor, whose service men have been fully instructed by our factory field service men along these lines.

In the event that there is any difficulty in handling the matter in this way, the dealer is at liberty to purchase or build a standard outfit for the purpose as described and advertised in various radio magazines, and set it up himself in accordance with the instructions furnished.

For convenience in describing the use of the test stand in the following paragraphs, the signal-producing apparatus will be referred to as the "transmitter," however, it is understood that the signal produced is of sufficient strength for set testing only.

(b) The "Galvanometer Test Stand"

This apparatus is essentially a contrivance for measuring the volume with which the signal from the transmitter is obtained on a receiving set, thereby indicating the sensitivity and condition of the set. The chief element in this outfit is a thermo-coupled galvanometer, to which the set to be tested is connected through an additional (third) stage of audio amplification followed

by a special "step-down" transformer, the secondary terminals of the latter being connected to the galvanometer. It should be clearly understood that the reading obtained on the galvanometer when a set is tested is of value only as a comparative reading—that is when compared with a standard set with a predetermined standard value.

The photograph below shows a form of test stand used in our factory service department. A "standard" receiving set is permanently connected to this stand,

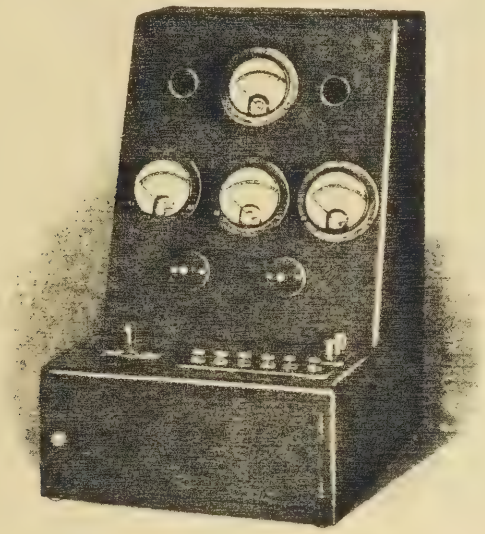


Fig. 26. Test Stand.

thereby permitting the comparative output of any set of the same type to be readily checked. A standard anti-capacity switch is used to connect the galvanometer outfit to either the standard or test receiver, as shown on the schematic wiring diagram of the complete test stand which appears on the next page. This diagram shows two permanent sets of connecting posts, one for a standard set and one for the "test" set, of the battery type, with the necessary supply cable leading to the power supply source; and also a "triple tap" receptacle permitting two sets to be connected to the 110 volt A. C. line when an A. C. set is to be compared with a standard.

When changing from a battery type standard set to an A. C. standard (or vice versa), it is only necessary to transfer the output leads from the speaker posts of one standard to the other and the antenna wire of the transmitter, from the antenna post of one standard to the other. A D. P. D. T. and an S. P. D. T. knife switch can be installed to accomplish these changes quickly.

(c) Procedure for Testing Sets

A suitable transmitter and the test stand described above comprise a complete outfit for testing the performance of any set in a very short space of time.

In order to facilitate the testing of any type of set a "standard" should be maintained for each type—either an actual standard set, selected as having the average output of several sets of its type known to be in good condition, or simply a standard value of output can be set as an arbitrary requirement. In describing the testing of a set below, it will be assumed that an actual standard set has been selected and is properly connected to the test stand.

To test a set, place it on the test bench convenient to the test stand, connect cable wires to proper binding posts on stand (if an A. C. set, simply plug in the "triple tap"), and antenna post to switch carrying antenna lead wire from transmitter. Turn on transmitter and adjust tuning control on same to a low wave length adjustment. Throw switch on test stand and antenna switch over to the standard set and "tune in" the signal on this set so that maximum reading is obtained on the galvanometer. Adjust tuning control of transmitter so that the signal comes in at 20 on the dial of the standard, then adjust position of antenna wire from transmitter till reading on test stand galvanometer is around 60, with volume control of set full on.

Now throw toggle switch and antenna switch over to the set being tested. If this is a battery set, the next procedure is to insert the tubes one at a time, noting by the filament ammeter "A" whether the proper current (¼ amp. each) is being drawn by the tubes. If the set being tested is an A. C. type, the tubes should all be inserted before the A. C. power plug is pushed into the receptacle. Turn dial of set being tested to approximately 20, the volume control being turned full on. The maximum galvanometer reading obtained around this point will give the comparative output of the test set with the standard.

Next set the transmitter tuning control so that a medium wave length signal is sent out and repeat the above procedure, adjusting so that a maximum reading is obtained around 50 on the dial of the standard set. Then compare the output of the two sets on this wave length.

Repeat same again with transmitter adjusted to a high wave and secure comparative readings at 80 on the dial of each set.

By comparing the volume of output of a set with a standard on three wave lengths by the above method, a very accurate idea of the performance of the set is obtained, since any defect in the set, such as an open circuit, or incorrect adjustment of the condensers, will readily be indicated by an abnormally low volume reading on the galvanometer. A reading of 20% or so below standard is, however, allowable.

(d) Special Notes

1—Tubes used in the standard sets should be very carefully selected with the aid of the dealer's tube-testing equipment.

2—It will be noted that the ammeter listed in the "Suggestions for Service Equipment" (Section II, paragraph 3) is employed in the test stand, in addition to the galvanometer. Several small fuses and switches, the purpose of which is self-evident, are also employed in the test stand circuit. The voltmeter for checking A. C. line voltage is connected across the A. C. line through the "triple tap," the connection between the first and second taps being broken and a single throw knife switch inserted between them.

3—Note that a pair of headphones or a loudspeaker unit is inserted in series with the plate circuit of either set, for checking the volume and quality of the signal from the signal-producing apparatus.

4—If desired, switches can be installed to arrange for a test on outside broadcasting as well as on the test transmitter, thereby giving a still more complete test.

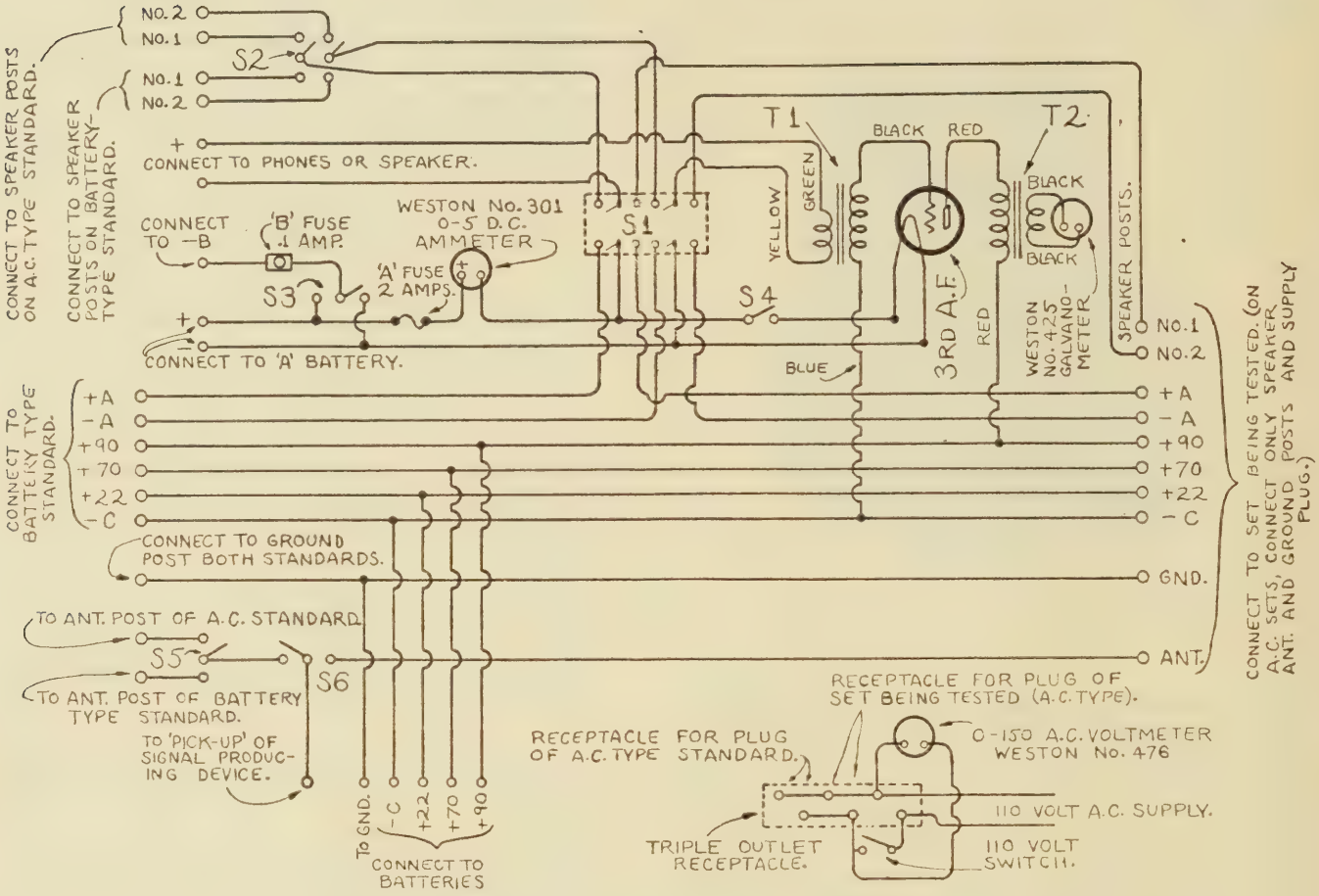


FIG. 27. WIRING DIAGRAM OF TEST STAND FOR A.C. AND BATTERY-TYPE RECEIVERS.

S1=Federal No. 1424 toggle switch (four pole, double throw) to switch phones and input of 3rd A.F. amplifier from standard to set being tested, and to change "A" battery from standard to set being tested (with battery-type sets).

S2=Double pole, double throw switch to change phones and input of 3rd A.F. amplifier from A.C. standard to battery-type standard.

S3=Single pole, double throw switch to change —B from +A to —A.

S4=Toggle switch to turn filament of 3rd A.F. amplifier "on" or "off."

S5=Single pole, double throw switch to change "pick-up" from A.C. type standard to battery-type standard. S5 and S2 may be combined to form a triple pole, double throw switch.

S6=Single pole, double throw switch to change "pick-up" from standard to set being tested.

T1=Atwater Kent No. 7660 audio frequency transformer.

T2=Atwater Kent special step-down audio frequency transformer.

NOTE.—The battery type standard may be a later-type Model 35 (with 17 plate variable condensers). The A.C.-type standard may be a Model 38 or 44.

NOTE.—Connect +C to —A.

SECTION IV

TROUBLES DUE TO EQUIPMENT, LOCATION AND INSTALLATION

1. Troubles Usually Not In Receiver

The first thought of the radio user, if his reception should deviate from its normal satisfactory functioning, is that the cause of the trouble is in his receiver.

The service man, however, will find in the majority of cases that something other than the set itself will be causing the trouble—either a defective tube, broken aerial or ground connection, battery trouble or some similar cause. Perhaps the customer himself is at fault, in not understanding the set, or he may be expecting the impossible. Perhaps the dealer who made the sale recklessly "oversold" the customer with unlimited promises of distant reception.

2. Method of Procedure In Locating Trouble

The accessories and installation should therefore be carefully checked first, and the general character of the location noted with a view to determining what sort of reception should be expected.

The method of procedure in locating the cause of a particular trouble will, of course, depend on the nature of the complaint. The dealer with even a moderate amount of experience in radio will instinctively know the step-by-step procedure in getting at the bottom of each type of complaint. In Section VIII will be found a "Chart of Troubles and Probable Causes" which will be of aid in doubtful cases, and below we are listing briefly the most frequent possible causes of trouble other than in the receiving set itself.

3. Classification of Troubles Due to Accessories

(a) Location

The conditions immediately surrounding the home in which a radio is installed will have a great influence on the success obtained in reception, particularly of distant stations.

In the immediate vicinity of numerous steel buildings, other aerials, powerful local broadcasting stations, etc., maximum results cannot be expected, although sometimes surprisingly good reception is experienced under adverse conditions. The ideal location for clearness and distance is in the open country on high ground, with as few surrounding objects, electric wires, etc., as possible, in the immediate neighborhood, although remarkable results are frequently obtained in locations which would ordinarily appear somewhat unfavorable.

In many cases, it is rather difficult to explain these facts to the radio owner, who does not understand why his set, in a downtown apartment house, will not bring in the distant stations as clearly as his cousin's set of exactly the same type located in the suburbs or the country. If, however, he can be induced to take his set to his cousin's home and connect it up there, his doubts will soon disappear, and he will be surprised at the performance of his set under the vastly improved local conditions.

(b) Aerial

May be (a) grounded, (b) touching foreign objects, (c) connections corroded; (d) lead-in may be broken inside insulation.

(c) Lightning Arrester

May be (a) leaky, or (b) short circuited.

(d) Ground Connection

May be (a) corroded where connected to pipe or other source of ground (b) ground lead may be broken inside insulation; (c) source of ground may be inefficient (dry earth, etc.).

(e) Batteries and Battery Eliminators

"A" or storage battery may be (a) discharged or run down—indicated by weak signals and necessity for advancing rheostats of set full on—temporarily relieved by turning off set for a short time if battery is not completely discharged. (b) Corroded connections at "A" battery terminals cause noisy and intermittent reception. Posts should be scraped clean and coated with vaseline to prevent further corrosion. (c) Reversed connections to the "A" battery will cause the set to be extremely weak. This simple trouble is found more frequently than might be thought possible, especially in cases where the battery is sent out to be recharged and is reconnected by the customer.

"A" battery eliminators. These are of various design and construction, and unless the dealer himself is handling them and has instructions for repair, it is better to refer the complaint to the seller or manufacturer of the device.

"B" batteries and "B" eliminators, particularly if of the liquid types, are often found to be the cause of a set becoming inoperative. Run down "B" batteries cause weak, noisy reception. A 45 volt dry "B" unit should be replaced when its voltage has dropped to 34 volts. This voltage should be measured with the set turned on.

Occasionally incorrect cable connections to the "B" battery will be found. All connections should be carefully checked by the service man, following the wiring diagram in the instruction book supplied with the particular set being tested.

One of the first steps the service man will make in testing for trouble, therefore, will be to test the voltage of the "B" batteries (dry or storage) with a voltmeter, and check the connections to them from the set.

"B" eliminators or power units are of many different types, the two main varieties being the tube rectifier type (such as our Model R) and the Electrolytic or liquid type. The voltage delivered by the unit should be checked with a high resistance voltmeter while the set is turned on, and if it is seriously incorrect, reference should be made to the service literature covering the particular make of unit, or the unit should be sent to the local representative for inspection.

(f) Tubes (D. C. and A. C.)

Defective tubes, both in A. C. and D. C. or battery type sets, are one of the most common causes of trouble in reception. A tube may light perfectly and yet be "dead" so far as reception is concerned, due to a loss of electronic filament emission.

In general, all tubes become weak or lose their sensitivity after a period of use, and the useful life of a radio tube generally ceases long before the filament actually burns out. Weak tubes can sometimes be brought back to normal functioning, at least temporarily, by the so-called "rejuvenators."

Occasionally, due to faulty interior construction, the internal elements of a tube will touch one another, causing a short circuit. If the grid and plate of a tube come in contact, due to their supports not being rigid or possibly to a slight jar to the set, while the set is connected up (but not necessarily turned on, if a battery set), the plate current will pass through the grid circuit, usually wholly or partly burning out the "grid resistance unit" and sometimes also the primary of the R. F. transformer. Unfortunately, when this occurs the filament of the tube is usually involved, resulting in its burning out, and rendering the tube unfit for further use. If the defective tube is in the first R. F. socket, the choke coil or coupling transformer will be the element of the set through which the plate current passes, consequently it will burn out.

There are also cases where this short circuit of the internal elements is only momentary, due to a slight shock or jar to the tube, unnoticed at the time by the set owner. In this case the damage may be only the partial or complete burning out of the grid resistance or choke coil, without damage to the tube itself. The latter will then function properly, but may again cause similar trouble at any time without warning. It is therefore very important that any tube which is suspected of having this defect, be located and replaced before further damage is done.

A. C. tubes, during the first few months after they appeared on the market, were subject to some rather peculiar troubles. The detector tube occasionally showed a tendency to develop trouble after a short period of use, under a line voltage only slightly in excess of normal. This has been attributed to the heavy current surge through the filament the instant the set was turned on. This condition has recently been almost entirely overcome by changes in the internal design of the tube. A defective A. C. amplifier tube of the "226" type may cause a hum in reception.

For best results it is advisable to use standard tubes of established national reputation. Information relative to the use of "power tubes" in our various battery type sets is contained in Section XI.

(g) Speaker

In a small percentage of cases of trouble in reception, the speaker will be found at fault. An open circuit in the magnet coil winding will make reception practically impossible, while incorrect adjustment or other abnormal conditions may cause distortion or lack of volume.

For this reason it is always advisable for the outside service man to have a speaker or reproducing unit of some sort in his service kit, for comparison purposes.

Where an inferior brand of speaker has been sold with an Atwater Kent receiver, as is sometimes done in order to make possible a lower or "bargain" price on the complete outfit, the performance of the set will naturally suffer to some extent, and the service man should in all such cases suggest replacing the present speaker with an Atwater Kent cone type, demonstrating one on the spot if available.

(h) House Current Supply (A. C. Sets)

Successful performance of an A. C. set will not be possible under conditions of line voltage other than those for which the set was designed. It need hardly be mentioned that attempting to use our standard 110 volt, 60 cycle sets on 110 volts D. C., 220 volts A. C., 32 volt farm lighting systems or 25 cycle, 110 volt A. C. lines will have disastrous results.

An allowable limit of ten volts either way, is permissible on the A. C. sets. Voltages below 100 will not permit maximum volume, while voltages above 120-125 would have a tendency to shorten the life of the tubes, except in the case of certain models, which are equipped with an automatic voltage regulator in the A. C. line, permitting line voltage variations up to 130 volts to be satisfactorily handled.

In localities where the A. C. line voltage runs from 10 to 20 volts or more above the standard value, at suitable resistance unit or voltage regulator may be used to bring the voltage to normal value. There are several such devices now being made by reputable concerns, and will be found advertised in current radio magazines. These devices are, of course, unnecessary with the sets having the automatic voltage regulator, unless the line voltage is excessively high (above 130 volts).

Section V

OUTSIDE INTERFERENCES—CAUSES AND REMEDIES

In addition to the cases in which unsatisfactory radio reception is due to faulty equipment or installation, there is also a considerable percentage of instances where disturbances due to external causes are responsible for the failure of a set to deliver satisfactory performance. In other words, a radio set will respond to other electrical radiations besides those of the broadcast stations, and in some cases these other radiations are of such intensity as to "drown out" distant, or in some cases, even local reception.

1. Determining if the Cause is External or Internal

The simple expedient of disconnecting the antenna and ground lead-in wires from the set, while it is in operation and the disturbance is being heard, will readily determine whether or not the noise is due to an external radiation or to some abnormal condition within the radio installation itself. If the noise disappears with the removal of the lead-in wires, it is undoubtedly due to external causes. The simplicity of this test will usually convince the most ignorant or skeptical radio owner.

2. Classification of External Causes

(a) Static

"Static" is a rather broad word used to cover the noises in reception caused by electrical discharges in the atmosphere due to natural causes. There is always a certain amount of this present, and the more sensitive the receiver is, the more readily it will be detected. A seven-tube tuned R. F. set will bring in static which might not be noticeable in a three-tube set, but, of course, the response to distant broadcast signals will be greater in the same proportion.

Static may be recognized as a crackling, crashing and rumbling sort of sound, usually intermittent and irregular in intensity. It is worse at night than during the day and worse in summer than through the winter. In the tropical localities it is present throughout a greater portion of the year.

The use of a long, low aerial, or even an "underground" aerial, one of the patent shielded types; or the disconnecting of the ground lead from the set, will frequently reduce the amount of static received, at some sacrifice in volume of the broadcast reception. It will be found best when listening under bad static conditions, to tune the desired station to maximum with the "station dial" and then turn down the volume control till a very moderate volume is obtained.

(b) Code Signals.

This noise is in the form of an intermittent buzzing or "peeping," resembling telegraphic code (dots and dashes), and is due to the operation of a powerful wireless telegraph transmitter, either commercial or amateur, in the immediate vicinity. Even if this transmitter is sharply tuned, if it is sufficiently close and powerful it may cause interference through "forced oscillations," which cannot very well be prevented. If it is a case of an improperly tuned transmitter, this can be reported to the Federal Radio Commission.

(c) Radiating Receivers

The familiar squeal or "cat-call," varying in intensity and volume, which is sent out or broadcast, when a regenerative or other oscillating receiver is "tuned in," is gradually disappearing from among the annoyances to which the broadcast listener is subject, as this class of set is steadily becoming obsolete and being replaced by the "stabilized" types. Interference of this kind can only be eliminated at its source, by proper operation of the offending receiver. Such cases can best be handled personally, by using diplomacy and tact with the owner of the trouble-causing set.

(d) Electrical Apparatus and Wiring.

Electrical machinery in operation and defective electric wiring is probably responsible for more "background noise" in radio reception than any other cause, particularly in a city or town where there are always many electrical devices, appliances and machinery in more or less continuous operation.

The nature of the noise in each case will depend upon the type of machinery causing it and the nature of the defect or electrical discharge responsible for the radiation of the disturbance. Among the more common sources of trouble of this nature may be mentioned:

Electric motors or generators,
Arc lights,
Household electric appliances,
Flashing signs,
X-ray or violet-ray machines,
Battery chargers (vibrating type),
Leaky electric power wiring,
Farm lighting systems,
Telephone bell-ringers,
and numerous other forms of electric apparatus, in fact any device which produces a spark while in operation.

The source of the noise can sometimes be found by careful investigation of the presence of electrical appliances, defective wiring, loose fuses or lamps, etc., in the building or the immediate neighborhood. For the tracing of larger and more obscure sources, however, the use of a small portable receiving set, operating from a loop antenna, can be resorted to. Tests made with such an outfit, located at various points in the neighborhood of the disturbance, noting the intensity of disturbance and direction the loop points, will often enable the origin of the interference to be located.

3. Remedies

It would not be possible here to attempt to suggest remedies for the various noises caused by different forms of electrical apparatus, however, we may say that generally speaking, the only satisfactory remedy in most cases consists of some sort of filter applied to the source of the disturbance, that is the sparking contacts from which the interfering radio frequency currents are radiated. This filter will consist of either a simple condenser, two condensers in series with a ground lead from the point of their connection, or two condensers so connected, in conjunction with R. F. chokes.

In a few cases some improvement in reception is had by changing the position of the receiving aerial, but the most practical procedure is to locate the source and apply one of the forms of filter suggested.

For a detailed treatise on this subject the dealer is referred to the "Manual on Interference" published by the Radio Manufacturers' Association.

SECTION V-a
DESCRIPTIVE LIST OF ATWATER KENT RECEIVERS

Part No.	Model No.	Tubes	
			"Open" or Board Type Battery Sets
4052	..	4	Type "11" tuner, 1 stage fixed R.F., det. and 2 stage amp. unit, potentiometer control.
4066	..	5	Type "11" tuner, 2 stages fixed R.F., det. and 2 stage amp. unit, potentiometer control.
4340	10	5	Two stages tuned R.F., 3 variable condensers, 3 R.F. transformers, detector, 2 stage unit and potentiometer. Gray-green condensers.
4445	9	4	One stage tuned R.F. amp., 2 tuners and det. 2 stage unit, potentiometer control.
4333	5	5	Type "11" tuner, 2 stages fixed R.F., det. and 2 audio—all tubes in one metal container.
4600	10	5	Two stages tuned R.F.—3 var. condensers, etc., same as No. 4340, but different wiring.
4550	10A & 10B	5	(10B has 3 tap ant. switch.) Similar to 4340. Brown conds., with battery cable attached.
4560	10A & 10B	5	(10B has 3 tap ant. switch.) Same as 4550, but black variable condensers.
4620	12	6	Two stages R.F., det. and 3 stages audio—3 variable condensers, cable attached.
4700	10	5	Similar to 4340 & 10B 4550-4560. No pot. One R.F. rheostat only for both R.F. tubes.
4910	12	6	Similar to 4620, but with switch to control last audio stage, and no potentiometer.
			Cabinet Type Battery Sets
4640	20	5	Two stages tuned R.F., large cabinet, 3 dials, 3 pt. ant. tap switch, 2 rheostats.
4880	19	4	One stage tuned R.F., large cabinet, 2 dials, 3 pt. ant. tap switch, 2 rheostats.
4920	24	5	Same as 4640, but in "deluxe" cabinet, with feet.
7570	20 Compact	5	Small mahogany cabinet, 3 dials, tap switch, battery cable attached.
7780	21	5	Same as No. 7570, but with sockets and rheostats for 3-volt dry cell tubes.
7960	20 Compact	5	Same as No. 7570, but with "UX" type sockets and other refinements.
8000	30	6	One tuning dial, small mahogany cabinet, two rheostats, 3 stages R.F.
8100	35	6	Metal cabinet, tubes inserted from bottom—one dial, one rheostat, ship-type name-plate.
8270	32	7	Long cabinet, one dial, two rheostats—4 stages R.F. double R.F. transformers.
8930	33	6	Small mahogany cabinet, one dial, ant. adj. knob, two rheostats, double R.F. transformers.
8500	50	7	Large deep mahogany cabinet, several metal shielded compartments inside, one dial, antenna adjusting knob, 2 rheostats.
9840	48	6	Similar to Model 30, but gold panel.
9860	49	6	Similar to Model 33, but gold panel.
			A.C. Sets—Using "A.C. Tubes"
9390	36	6 and rect.	Small mahogany cabinet, same as Model 33; Type Y (metal), A.C. power unit goes with Model 36 set.
9500	37	" " "	Metal cabinet contains set and power unit, 3 stages R.F., 1 dial, 1 volume control knob, ship-type nameplate.
9400	38	7 " "	Same as Model 37, but double R.F. transformers and 4 stages R.F. amp., 1 dial.
9800	40	6 " "	Same as Model 37, metal cabinet, but black dial and volume knob and other minor differences; modernistic nameplate.
9850	42	" " "	Same as Model 40, but with automatic voltage reg., ball feet, dial in 5 divisions.
9900	44	7 " "	Same as Model 42, but with double R.F. transformers, 4 stages R.F. amp.
9930	52	6 " "	Console type—metal stand, speaker in base, antenna and ground leads supplied; set chassis same as Model 42.
			Direct Current (110-Volt) Sets
9910	41	7	Metal cabinet contains set and power unit, 3 stages R.F., detector, 2 stages A.F. (last stage "push-pull" type, 2 tubes, one mounted on right-hand side of power unit). Filaments in series. Chassis similar in appearance to Models 37, 40, 42 and 52.

SECTION VI

SERVICING RECEIVERS AND A. C. POWER UNITS

When a thorough inspection of the customer's installation, etc., shows conclusively that the cause of the trouble lies within the set itself, the best plan is for the service man to disconnect the set and take it to his shop for test and repairs.

In a few cases, where the trouble is a very minor one, it would perhaps be permissible for the service man, if experienced and capable, to make repairs in the set owner's home, but with the full shop equipment and absence of a critical audience, a more satisfactory and permanent job can almost always be done.

Moreover, it is always well to apply a complete volt-meter test to a set which has given trouble, as well as to check the alignment of the condensers and thoroughly inspect the wiring with a view to eliminating the possibility of any future trouble developing.

The main tests to be applied to a set which comes in for repair, may be classified as follows, applied in order named:

(1) Visual inspection.
(2) Continuity tests, with volt-meter.
(3) Voltage tests (A. C. sets only).

The conducting of these tests will now be outlined.

1. Visual Inspection

In order to make a satisfactory visual inspection of the wiring and condition of the parts in a receiver, it is necessary to remove the set from the cabinet. This presents no particular difficulties, and by following instructions given in connection with service data on individual sets, the procedure can be accomplished in a minimum of time.

Points for Inspection

The following features should be given special attention in making the general visual inspection:

1—SOLDERED JOINTS—examine for firmness. A poor physical joint means a poor electrical connection. **Note especially ground lug connections.**

2—SCREWS, BOLTS AND NUTS—must be all tight.

3—INSULATION ON WIRING—must be perfect and not cut or frayed through where it passes metal edges of tube contacts, etc.

4—TUBE SOCKET FINGERS—should be clean and tight.

5—SWITCHES—switch blades should be clean and make good contact.

6—DIALS—should not scrape on panel.

7—GRID RESISTANCES—note if intact and tightly riveted on.

8—R. F. TRANSFORMERS—examine for loose or damaged coils, or bad connections at terminals.

9—VARIABLE CONDENSERS—check for foreign particles between plates and note spacing between rotary and stationary plates.

10—RHEOSTATS or VOLUME CONTROL—must operate smoothly.

11—POWER SUPPLY CABLE—note condition of insulation on leads and condition of terminals at power end.

12—POWER UNIT (A. C. SETS)—cable connection panel must be bolted down tightly.

13—SUPPLY CABLES (A. C. SETS)—note if cut by power unit lid.

2. Continuity and Voltage Tests

After set has been thoroughly checked by visual inspection in accordance with paragraph 1, the next step toward locating possible defects will be to apply the series of circuit continuity tests. These tests should be made even though the condition which apparently caused the complaint has been located through the visual inspection.

In case of the A. C. sets, it will be necessary also to check the voltages supplied to the various circuits by the power unit. Voltage tests are unnecessary in the case of the battery type sets, since the batteries or other sources of voltage are usually checked individually before attempting to apply any tests to the set chassis.

The following pages contain complete sets of continuity tests for all A. K. receiving sets manufactured since 1924, and also for the power units used in the A. C. type receivers. A complete voltage table covering all A. C. sets will be found at the end of this section.

The following abbreviations are used in the continuity test charts:

Abbreviation	Meaning
1 R	1st radio frequency socket
2 R	2nd " " "
3 R	3rd " " "
4 R	4th " " "
D	Detector socket
1 A	1st audio frequency socket
2 A	2nd " " "
3 A	3rd " " "
+ F	Positive filament contact
— F	Negative " "
G	Grid contact
P	Plate "
C (in A. C. sets)	Cathode "
R. F. T.	Radio frequency transformer
A. F. T.	Audio " "

In the tables, to identify a certain contact of a certain socket, the abbreviation of the contact is combined with the abbreviation of the socket.

Thus the grid (G) contact of the third R. F. socket is referred to as G3R. The negative filament contact of the second A. F. socket is referred to as —F2A, the cathode of the detector socket (in A. C. sets) would be CD, P2A would mean the plate contact of the second audio frequency socket, and so on.

The use of these symbols will enable the service man quickly to recognize the corresponding socket on the set without having to refer to the chart or wiring diagram.

Model 10B Receiver—Test Chart, Continuity Table and Diagram

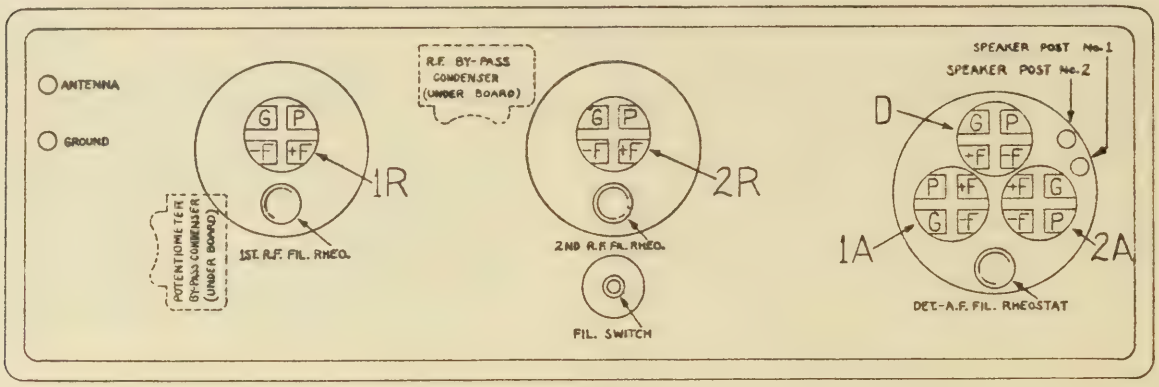


FIG. 28.

(For Following Tests, Place Filament Switch "On," Rheostats Barely "On" and Potentiometer Pointer to Left)
NOTE: Unsolder +F Lead to Potentiometer, and One Lead to Potentiometer By-Pass Condenser.

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
Each cable lead end to corresponding soldered cable connection under board.	*Full*	Open in cable.	Examine cable for broken leads and short circuits. Repair or replace cable if necessary.
BLACK to			
—F1R	*Full*	Open 1st R.F. fil. rheostat or connection.	Examine joints under board.
—F2R	*Full*	Open 2nd R.F. fil. rheostat or connection.	Examine joints under board.
—FD, —F1A, —F2A	*Full*	Open Det.-A.F. fil. rheostat or connection.	Examine joints under board.
Ground Post.	*Full*	Open ground connection.	
Antenna Post.	*Full*	Open antenna coil or connection.	Test with ant. switch on each tap.
G1R	*Full*	Open antenna coil or connection.	
P1R, P2R	*None*	No. 1, 2 R.F.T. primary circuit grounded.	Check transformer connections.
PD, P1A	*None*	No. 1, 2 A.F.T. primary circuit grounded.	Examine connections.
G2R	*Full*	Open secondary No. 1 R.F.T.	
G1A, G2A	*Partial*	None—Open secondary No. 1, 2 A.F.T.	Full—Shorted secondary.
RED to			
+F of Each Socket.	*Full*	Open positive filament wire or connection.	Examine joints under board.
PD	*None*	Shorted phone condenser.	Located inside 3-tube container.
GD	*None*	Shorted grid condenser.	Located inside 3-tube container.
P1R	*None*	Shorted R.F. plate circuit by-pass condenser.	Install new type by-pass cond.
WHITE to P1R	*Full*	Open primary No. 1 R.F.T.	
WHITE to P2R	*Full*	Open primary No. 2 R.F.T.	
YELLOW to PD	*Partial*	None—Open primary No. 1 A.F.T.	Full—Shorted primary.
BROWN to			
P1A	*Partial*	None—Open primary No. 2 A.F.T.	Full—Shorted primary.
Speaker Post No. 2.	*Full*	Open connection.	
OTHER TESTS			
Across End Terminals of Potentiometer.	*Nearly Full*	None—Open potentiometer.	Full—Shorted potentiometer.
Across Terminals of Potentiometer Cond.	*None*	Shorted potentiometer by-pass condenser.	Located under board, left-front. Install new type by-pass cond.
BLACK to			
Center Contact of Potentiometer (turn knob.)	*Nearly Full*	Open connection to slider.	

Resolder Connections to Potentiometer and By-Pass Condenser.

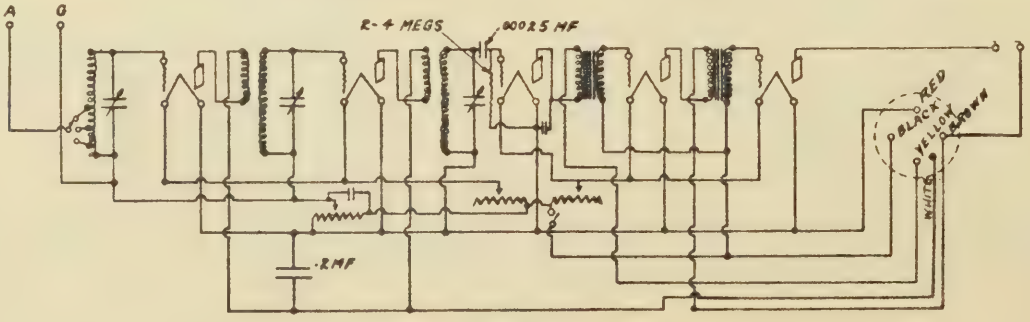


FIG. 29.

NOTE.—This set has two R.F. rheostats (one for each R.F. tube). —F1R connects to the slider lead of the 1st R.F. rheostat instead of to —F2R.

Model 10 Receiver—Test Chart, Continuity Table and Diagram

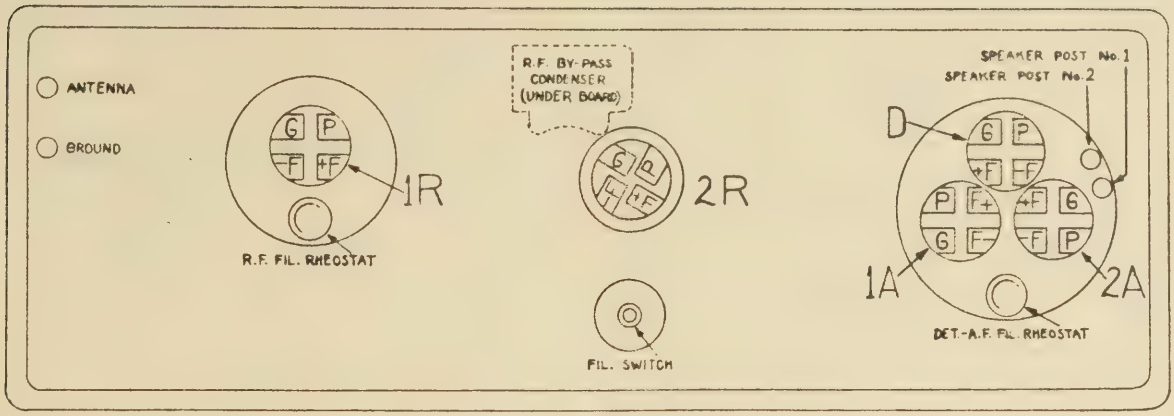


FIG. 30.

(For Following Tests, Place Filament Switch "On" and Rheostats Barely "On")

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
Each cable lead end to corresponding soldered connection under board.	*Full*	Open in cable.	Examine cable for broken leads and short circuits. Repair or replace cable if necessary.
BLACK to			
—F1R, —F2R	*Full*	Open R.F. filament rheostat or connection.	Examine joints under board.
—FD, —F1A, —F2A	*Full*	Open Detector-A.F. rheostat or connection.	Examine joints under board.
Ground Post.	*Full*	Open ground connection.	
Antenna Post.	*Full*	Open antenna coil or connection.	Test with ant. switch on each tap.
G1R	*Partial*	Open antenna coil or first grid resistance.	1st grid resis. located inside ant. coil.
P1R, P2R	*None*	No. 1, 2 R.F.T. primary circuit grounded.	Check transformer connections.
PD, P1A	*None*	No. 1, 2 A.F.T. primary circuit grounded.	Examine conn. in 3-tube container.
G2R	*Partial*	Open sec. No. 1 R.F.T. or 2nd grid res.	No. 2 grid res. inside No. 1 R.F.T.
G1A	*Partial*	None—Open secondary No. 1 A.F.T.	Full—Shorted secondary.
G2A	*Partial*	None—Open secondary No. 2 A.F.T.	Full—Shorted secondary.
RED to			
+F of each Socket.	*Full*	Open positive filament wire or connection.	Examine joints under board.
PD	*None*	Shorted phone condenser.	Located inside 3-tube container.
GD	*None*	Shorted grid condenser.	Located inside 3-tube container.
P1R	*None*	Shorted plate circuit by-pass condenser.	Located under board.
Ground Post.	*None*	Grounded positive filament circuit.	Inspect wir. for accidental grounds.
YELLOW to PD	*Partial*	None—Primary No. 1 A.F.T. open.	Full—Pri. No. 1 A.F.T. shorted.
BROWN to			
P1R	*Full*	Primary No. 1 R.F.T. open.	
P2R	*Full*	Primary No. 2 R.F.T open	
P1A	*Partial*	None—Primary No. 2 A.F.T. open.	Full—Pri. No. 2 A.F.T. shorted.
Speaker Post No. 2.	*Full*	Open connection.	
OTHER TESTS			
P2A to Spkr. Post No. 1.	*Full*	Open connection.	

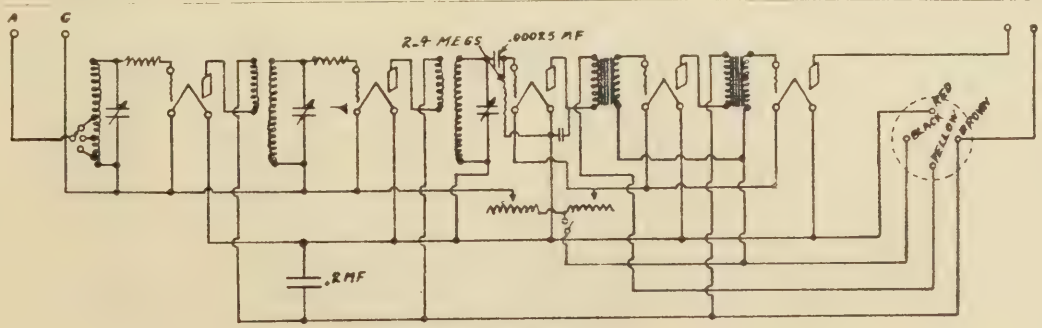


FIG. 31.

Model 12 Receiver—Test Chart, Continuity Table and Diagram

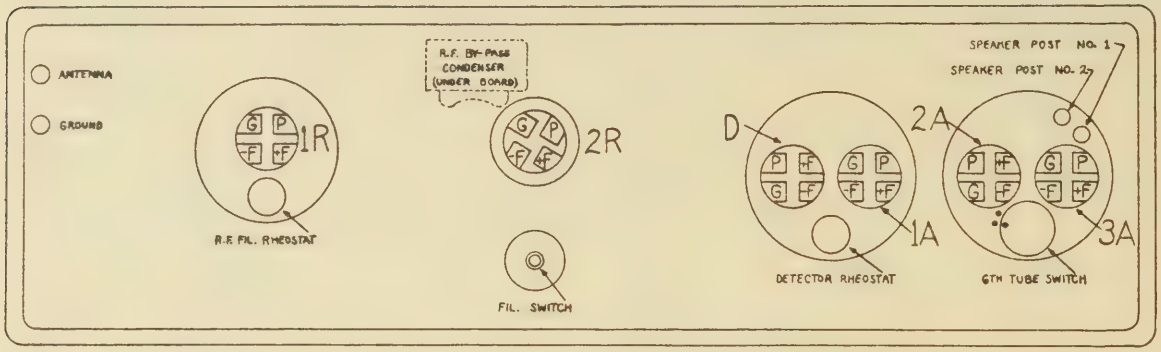


FIG. 32.

(For Following Tests, Place Filament Switch "On" and Rheostats Barely "On")

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
Each cable lead end to corresponding soldered end under board.	*Full*	Open in cable.	Examine cable for broken leads and short circuits. Repair or replace cable if necessary.
BLACK to			
—F1R, —F2R	*Full*	Open R.F. filament rheostat or connection.	Examine joints under board.
—FD, —F1A	*Full*	Open Det.-1st A.F. fil. rheo. or connection.	Examine joints under board.
—F2A, —F3A	*Full*	Open fixed resistance A.F. filament.	Located inside right hand container.
Ground Post.	*Full*	Open ground connection.	
Antenna Post.	*Full*	Open antenna coil or connection.	Test with ant. switch on each tap.
G1R	*Partial*	Open antenna coil or first grid resistance.	No. 1 grid resistance inside ant. coil.
P1R, P2R	*None*	No. 1, 2 R.F.T. primary circuit grounded.	Check transformer connections.
PD, P1A, P2A	*None*	No. 1, 2, 3 A.F.T. primary circuit grounded.	Examine conn. in 2-tube cases.
G2R	*Partial*	Open sec. No. 1 R.F.T. or No. 2 grid res.	No. 2 grid res. inside No. 1 R.F.T.
G1A, G2A, G3A	*Partial*	None—Open secondary No. 1, 2, 3 A.F.T.	Full—Shorted secondary.
RED to			
+F of R.F., Det., 1st and 2nd A.F.	*Full*	Open positive filament wire or connection.	Examine joints under board.
+F3A (6th Tube Switch to Rt.)	*Full*	Open wire or defective switch.	No reading with switch turned left.
PD	*None*	Shorted phone condenser.	Located inside Det.-1st A.F. case.
GD	*None*	Shorted grid condenser.	Located inside Det.-1st A.F. case.
P1R	*None*	Shorted R.F. plate circuit by-pass condenser.	Located under board.
YELLOW to			
PD	*Partial*	None—Open primary No. 1 A.F.T.	Full—Shorted primary.
BROWN to			
P1R	*Full*	Open primary No. 1 R.F.T.	
P2R	*Full*	Open primary No. 2 R.F.T.	
P1A	*Partial*	None—Open primary No. 2 A.F.T.	Full—Shorted primary.
P2A (6th Tube Switch to Rt.)	*Partial*	None—Open primary No. 3 A.F.T.	Full—Shorted primary (no reading with switch turned left.)
Speaker Post No. 2.	*Full*	Open connection.	

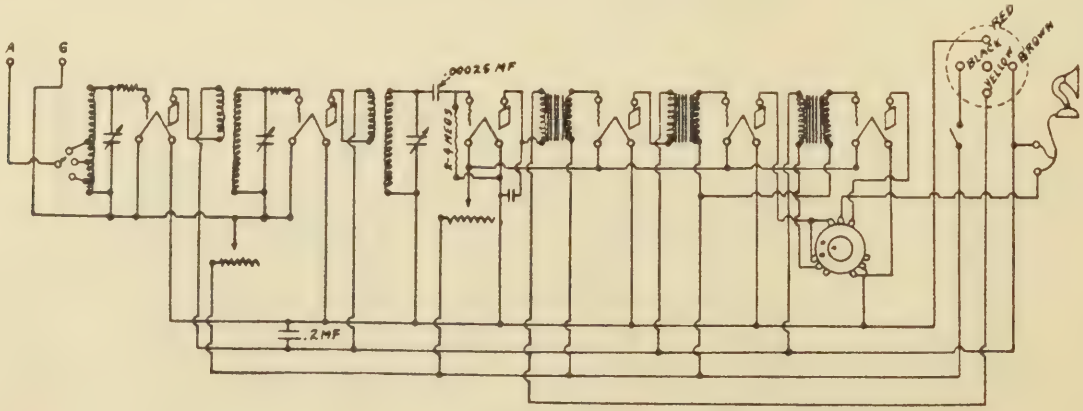


FIG. 33.
(Diagram shows one rheostat controlling detector and all three A.F. tubes. In actual set, rheostat controls detector and 1st audio only, 2nd and 3rd audio tubes being on separate fixed resistances.)

Model 20 No. 4640 Receiver—Test Chart, Continuity Table and Diagram

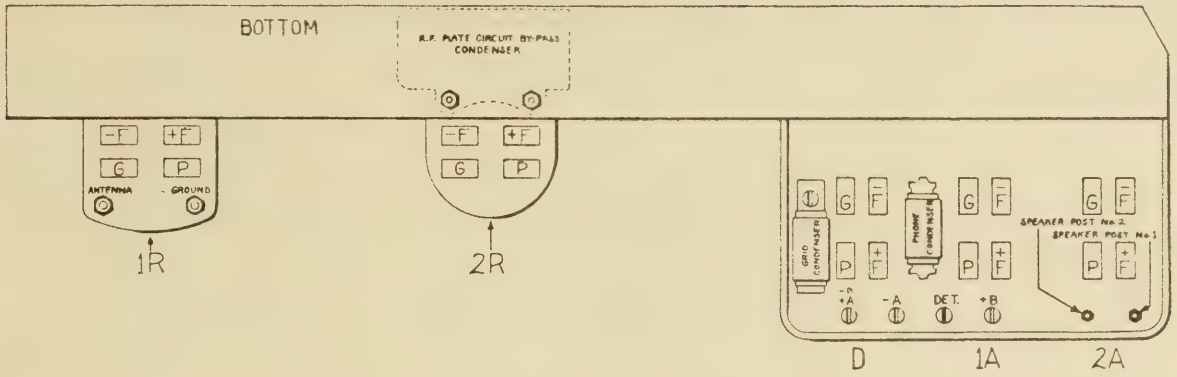


FIG. 34.

(For Following Tests, Place Filament Switch "On" and Rheostats Barely "On")

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
—A POST to			
—F1R, —F2R, Ground Post.	*Full*	Open in R.F. filament rheo. or connections.	
—FD, —F1A, —F2A	*Full*	Open in Det.-A.F. fil. rheo. or connections.	
Antenna Post.	*Full*	Open antenna coil or connection.	Test with antenna switch on each of 3 points.
+B Post.	*None*	Shorted R.F. by-pass condenser or grounded R.F.-1st A.F. plate circuit.	If necessary, unsolder by-pass condenser connection and test separately. Examine plate circuits for accidental grounds.
G1R	*Nearly Full*	Open antenna coil or first grid resistor.	Test sec. and grid res. separately. Grid resistors are mounted on back of R.F. var. condensers.
G2R	*Nearly Full*	Open secondary No. 1 R.F.T. or open second grid resistor.	Test sec. and grid res. separately. Grid resistors are mounted on back of R.F. var. condensers.
GD	*None*	Shorted detector grid condenser.	
G1A	*Partial*	None—Open secondary No. 1 A.F.T.	Full—Shorted secondary.
G2A	*Partial*	None—Open secondary No. 2 A.F.T.	Full—Shorted secondary.
Stator of Detector Variable Condenser.	*Full*	Open secondary No. 2 R.F.T.	
+A, —B POST to			
+F of All Sockets.	*Full*	Open positive filament circuit.	
PD	*None*	Shorted phone condenser.	
+20 (DET.) POST to			
PD	*Partial*	None—Open primary No. 1 A.F.T.	Full—Shorted primary.
+B POST to			
P1R	*Full*	Open primary No. 1 R.F.T.	
P2R	*Full*	Open primary No. 2 R.F.T.	
P1A	*Partial*	Open primary No. 2 A.F.T.	Full—Shorted primary.
Speaker Post No. 2.	*Full*	Open connection.	

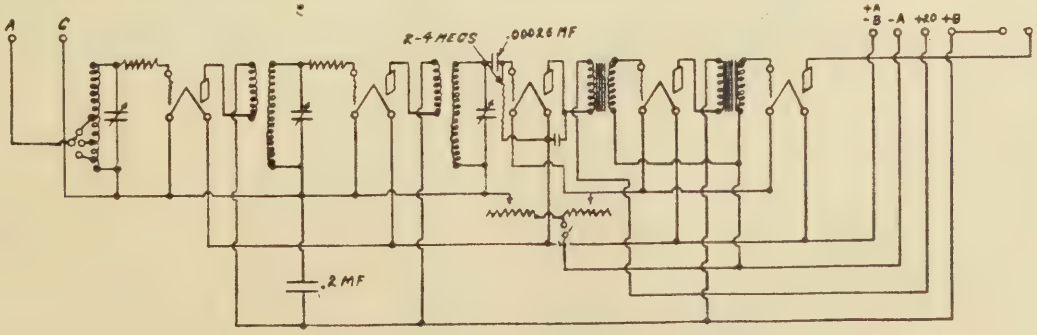


FIG. 35.

Model 20 Compact Receiver—Continuity Table

(For Following Tests, Place Filament Switch "On" and Rheostats Barely "On")

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
			NOTE: Examine cable for broken leads, broken connections and short circuits. Repair or replace cable if necessary.
BLACK to			
—F1R, —F2R, Ground Post.	*Full*	Open R.F. rheostat or connection.	R.F. rheostat at left.
—FD (7960 Set).	*Full*	Open detector rheostat or connection.	Detector rheostat at right.
—F1A, —F2A (7960 Set).	*Full*	Open A.F. filament fixed resistance.	Green insulated wire between rheostat assembly and —F1A.
—FD, —F1A, —F2A (7570 Set).	*Full*	Open Detector-A.F. filament rheostat or connection.	Detector-A.F. rheostat at right.
+FD (7960 Set).	*Nearly Full*	Open detector grid bias resistance.	
Antenna Post.	*Full*	Open primary antenna transformer or defective tap switch.	Test with antenna switch on each of 3 taps.
G1R	*Partial*	Open secondary antenna transformer or open first grid resistance.	Test secondary and grid resistor separately. Grid resistors mounted on back of R.F. variable condensers.
P1R, P2R	*None*	No. 1, 2 R.F.T. primary circuit grounded.	Or shorted by-pass condenser. (Unsolder lead and test condenser separately.)
PD	*None*	No. 1 A.F.T. primary circuit grounded.	Or shorted phone condenser (on 7960 set).
P1A	*None*	No. 2 A.F.T. windings grounded.	Examine transformer connections.
G2R	*Partial*	None—Open secondary No. 1 R.F.T. or open grid resistor.	Full—Shorted grid circuit or shorted grid resistor.
GD	*None*	Shorted grid condenser.	Mounted on det. var. condenser.
G1A (7960 Set).	*Partial*	None—Open secondary No. 1 A.F.T.	Full—Shorted secondary.
Stator of Detector Variable Condenser.	*Full*	Open secondary No. 2 R.F.T.	
RED to			
+F of All Sockets.	*Full*	Open positive filament circuit.	
PD (7570 Set).	*None*	Shorted phone condenser.	
WHITE to			
P1R	*Full*	Open primary No. 1 R.F.T.	
P2R	*Full*	Open primary No. 2 R.F.T.	
P1A (7960 Set).	*Partial*	None—Open primary No. 2 A.F.T.	Full—Shorted primary.
YELLOW to			
PD	*Partial*	None—Open primary No. 1 A. F. T.	Full—Shorted primary.
BROWN to			
Speaker Post No. 2.	*Full*	Open cable lead or connection.	
P1A (7570 Set).	*Partial*	None—Open primary No. 2 A.F.T.	Full—Shorted primary.
OTHER TESTS			
P2A to Speaker Post No. 1.	*Full*	Open connection.	
—C Lead to G2A	*Partial*	None—Open secondary No. 2 A.F.T.	Full—Shorted secondary.
—C Lead to G1A (on 7570 Set).	*Partial*	None—Open secondary No. 1 A.F.T.	Full—Shorted secondary.

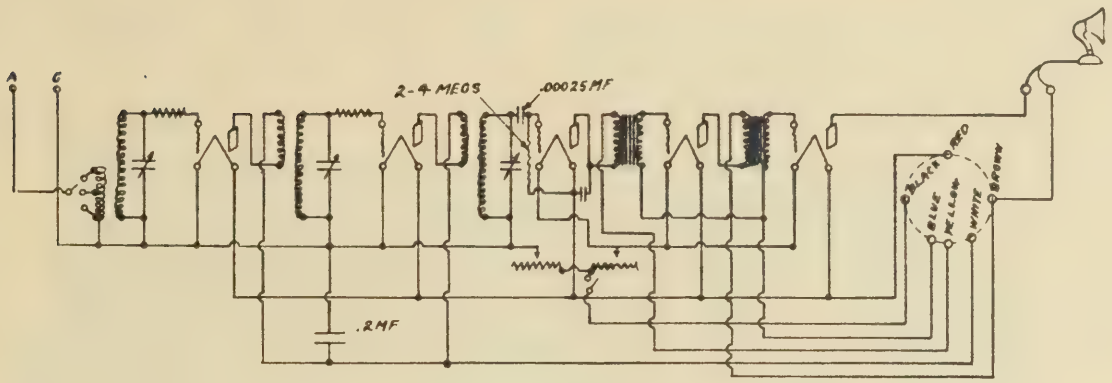


FIG. 36. MODEL 20 COMPACT SET NO. 7570. WIRING DIAGRAM.

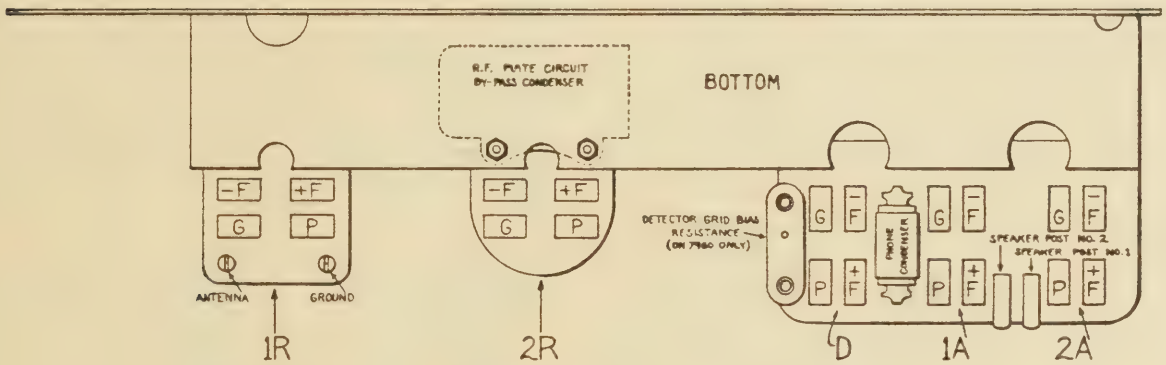


FIG. 37. TESTING CHART FOR MODEL 20 COMPACT (BOTH TYPES).

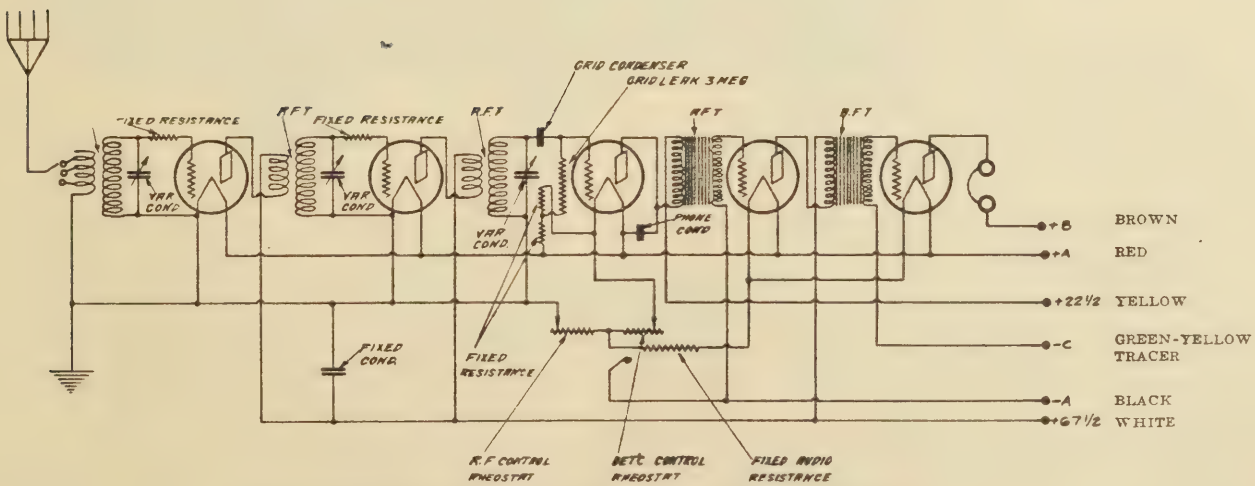


FIG. 38. MODEL 20 COMPACT SET NO. 7960. WIRING DIAGRAM.

Models 30, 35 and 48 Receiving Sets

General Description

The circuits of Models 30, 35 and 48 receivers are practically identical. Each has six tubes and single dial control. There are three stages of radio frequency amplification, a tuned detector, and two stages of audio frequency amplification. The first R. F. stage is untuned, being used as an antenna coupling tube for the purpose of eliminating the effect of different sizes of antenna systems on the synchronism of the three tuned circuits.

In Models 30 and 48 one rheostat controls the filaments of the three R. F. tubes, and another rheostat controls the detector filament. A fixed resistance is connected in series with the filaments of the two A. F. tubes.

In Model 35 one rheostat controls the three R. F. filaments and a fixed resistance is connected in series with the filaments of the detector and two A. F. tubes.

Model 30 (Early Type) has moulded end-plate variable condensers and three separate sockets for the R. F. tubes. Model 30 (Later Type) has metal frame variable condensers and a single moulded base for the three R. F. sockets.

Model 48 is similar to the later Model 30, but has a gold-finished panel and other minor refinements.

The chassis of Model 35 is similar in appearance to the later Model 30 and to Model 48, but it is mounted inverted inside a metal cabinet that is open on the bottom.

1. Model 35. Removing Chassis from Cabinet

Remove dial and vernier knob. Unscrew six bolts holding bottom rim to cabinet and remove rim. Remove six screws, three in a row at each end of the vertical side of metal frame. (Use magnetized screw driver.)

With top of cabinet on table, pull chassis back slightly to clear condenser shaft and rheostat knob, then lift set up and out, tilting chassis so the filament switch knob is inclined away from the table in order that the switch knob will clear the cabinet.

2. Model 30 (Later Type) and Model 48. Removing Chassis from Panel

Remove dial and vernier knob. Remove six screws, three in a row at each end of vertical side of metal frame. The panel may then be removed.

3. Model 30 (Early Type). Replacing Sub-Panel Assembly

Remove set from cabinet. Remove dial and vernier knob. Unsolder leads from sub-panel assembly. Remove three screws in front panel at center variable condenser and four screws along the bottom. It is necessary to remove bolts on the third R. F. socket and remove fixed by-pass condenser in order to change the sub-panel assembly. (If the by-pass condenser is of old style—brown color—replace with No. 8685.) Remove sub-panel assembly.

Attach the replacement sub-panel assembly, without tightening screws, and replace the fixed condenser, which is held by the two bolts passing through the third R. F. socket. The edge of the by-pass condenser must not be caught under the bottom angle of the sub-panel frame. Tighten screws holding sub-panel, solder connections exactly as the original, assemble set, and synchronize condensers. (See Section XI.)

4. Replacing Condenser Group in Models 30 (Later Type), 35 and 48

Remove chassis from cabinet or panel. Loosen nine screws holding condensers to front of metal frame. Note how pulleys and belts are arranged and then remove them. Replace one condenser at a time. Do not mix old condensers with the replacements.

Remove two nuts on back of first variable condenser, which clamp grid resistor (grid condenser on third variable condenser) and lug of secondary lead. Remove three screws holding condenser to chassis and lift out the condenser.

Put in the replacement condenser and its three screws, without tightening screws. Attach grid resistor and lug of secondary lead to top and bottom bolts respectively on back of condenser. Repeat procedure with other two variable condensers. When the replacement condensers are installed, put on the pulleys and belts, adjust belt tension and synchronize condensers. (See Section XI.)

5. Replacing R. F. Amplifier Assembly in Models 30 (Later Type), 35 and 48

Remove chassis from cabinet or panel. The R. F. amplifier assembly consists of three R. F. transformers mounted on a moulded three-socket base. The filament contacts are wired and have two leads for connection to rest of set; the plate circuits are wired and have one lead for connection to the +B, R. F. (white) cable lead. A lead from the grid-end of each R. F. transformer secondary is soldered to a lug which is to be fastened to the bottom bolt on back of the variable condenser in front of each R. F. transformer.

In replacing R. F. amplifier assembly, remove the old assembly by unsoldering the R. F. by-pass condenser lead, lead from grid of first R. F. socket, leads from grid resistors (unsolder at grid contacts of socket), two filament circuit leads (at points where they connect to rest of set), and the +B, R. F. lead. Remove secondary wire lug from bottom bolt on each variable condenser. Unsolder, at grid contact of detector socket, the lead from grid condenser, which passes through a hole in the R. F. base. Unsolder lead from ground lug to negative side of R. F. filament circuit. Remove five bolts holding R. F. base to metal chassis and remove the old R. F. amplifier assembly.

Reassemble with replacement R. F. amplifier, reversing above procedure.

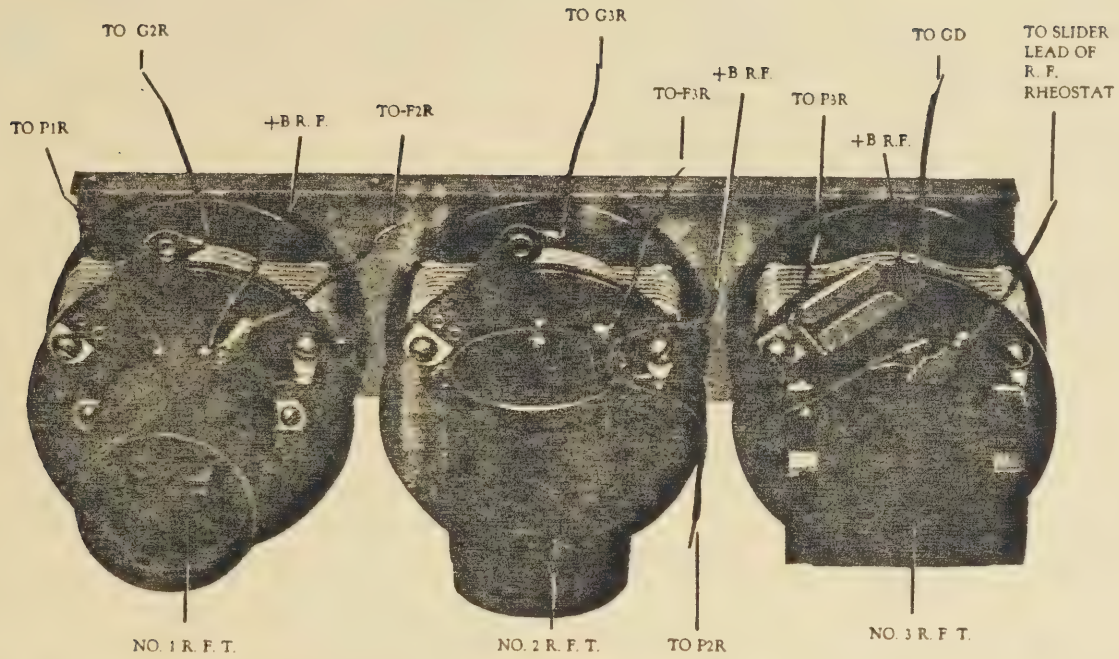


FIG. 39. VIEW OF SUB-PANEL ASSEMBLY MODEL 30 (Early Type), SHOWING WHERE EACH LEAD IS TO BE CONNECTED.

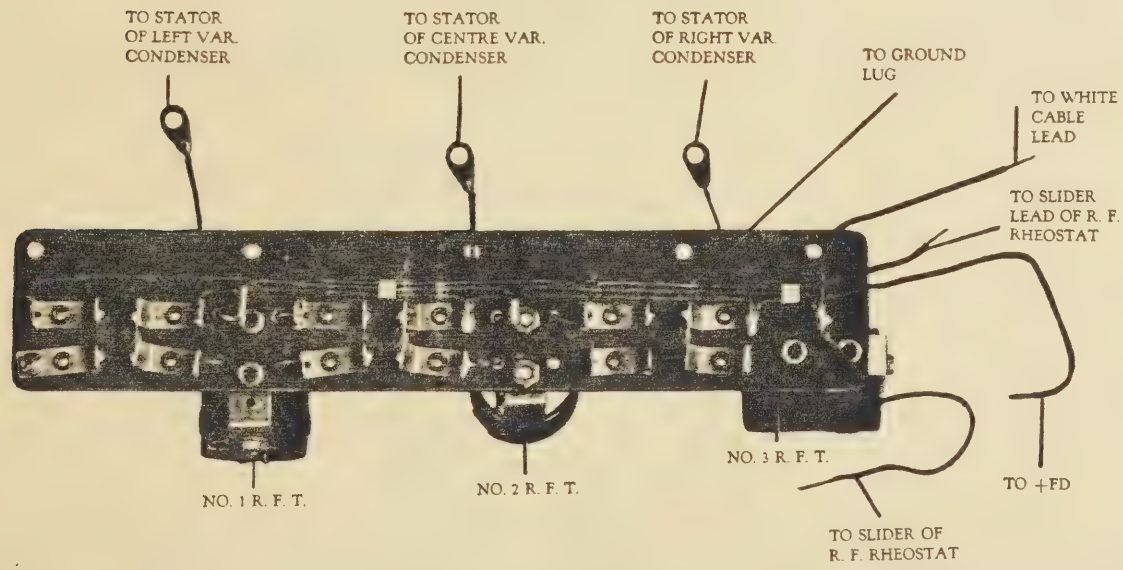


FIG. 40. VIEW OF R.F. AMPLIFIER ASSEMBLY IN MODELS 30 (Later Type), 35 AND 48, SHOWING WHERE EACH LEAD IS TO BE CONNECTED.

Replacing R. F. Transformers, Variable Condensers or Grid Resistors in Models 30, 35 and 48

MODEL OF SET	If One R. F. Transformer is Defective	If One Variable Condenser is Defective	If One Grid Resistor is Defective
MODEL 30 (with moulded end-plate condensers)	Replace Sub-panel Assembly No. 8,185. This consists of a metal frame, three variable condensers, three R. F. transformers, two grid resistors, and one grid condenser, all mounted in place, with pulleys and belts adjusted.	Replace Sub-panel Assembly No. 8,185.	Replace defective resistor No. 8,092.
MODEL 30 (with metal frame condensers)	Replace R. F. Amplifier Assembly No. 8,449 for sets between Serial Nos. 636,101 and 639,358. No. 9,030 for sets above Serial No. 644,351.	Replace group (No. 9,100) of three variable condensers. Use pulleys and belts of original group.	Replace defective resistor No. 8,439.
MODEL 35	Replace R. F. Amplifier Assembly No. 8,108 for sets previous to Serial No. 900,000. No. 8,440 for sets between Serial Nos. 900,000 and 955,700. No. 9,020 for sets after Serial No. 955,700.	Replace group of three variable condensers. No. 9,201 (13 plates) for sets previous to Serial No. 900,000. No. 9,100 (17 plates) for sets after Serial No. 900,000. Use pulleys and belts of original group.	Replace defective resistor No. 8,225 for sets previous to Serial No. 900,000. No. 8,439 for sets after Serial No. 900,000.
MODEL 48	Replace R. F. Amplifier Assembly No. 9,030.	Replace group of three variable condensers. No. 9,100. Use pulleys and belts of original group.	Replace defective resistor No. 8,439.

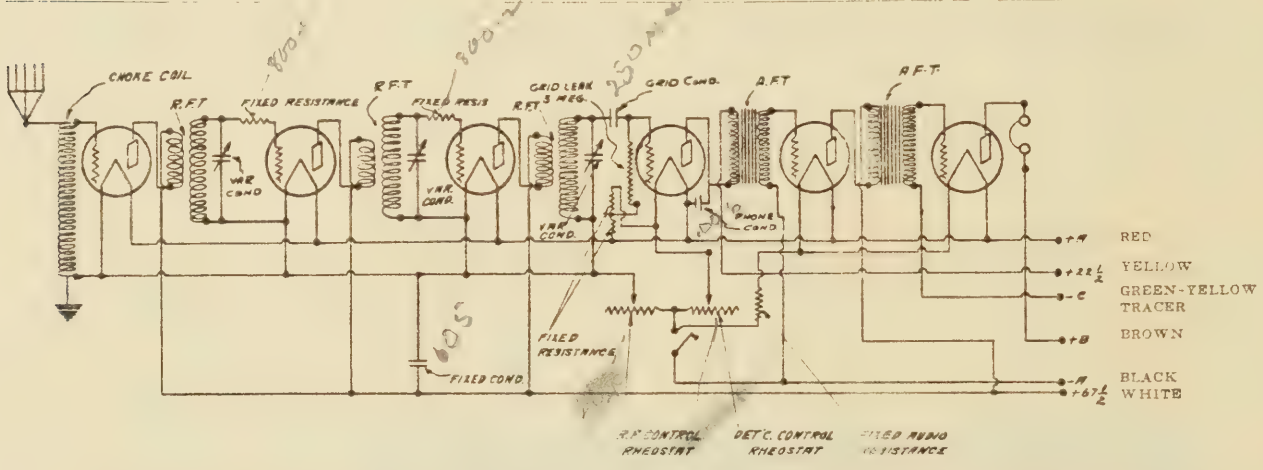


FIG. 41. WIRING DIAGRAM OF MODELS 30, 35 AND 48. (In Model 35, one rheostat controls the three R.F. filaments and a fixed resistance is connected in series with the detector and two A.F. filaments.)

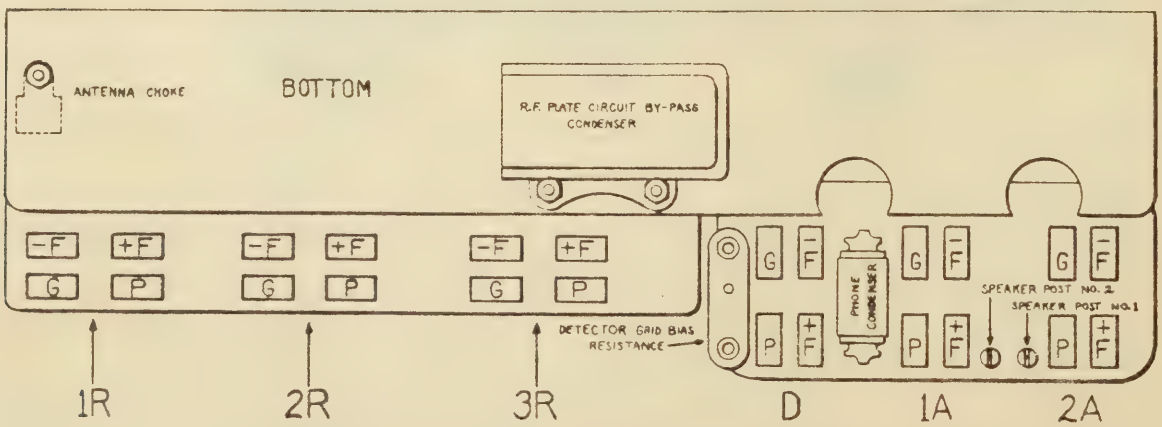


FIG. 42. TEST CHART FOR MODELS 30, 35 AND 48.

NOTE.—Early Model 30 Sets have separate R.F. sockets, but the socket contacts are in same relative position as shown in above chart.

Continuity Test Table—Models 30, 35 and 48

(For Following Tests, Place Filament Switch "On" and Rheostats Barely "On")

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
			Examine cable for open leads, broken connections and short circuits. Repair or replace cable if necessary.
BLACK to			
—F of R.F. Sockets.	*Full*	Open R.F. filament rheo. or connections.	R.F. filament rheostat at left (on Models 30 and 48).
—F of A.F. Sockets.	*Full*	Open A.F. fil. fixed resis. or connections.	Green insulated wire from rheostat assembly to —F1A.
—FD	*Full*	Open detector filament rheostat or connections. (Models 30 and 48.)	Or open connection to det.-A.F. fil. fixed resis. (Model 35).
Ground Post.	*Full*	Open connection.	
Antenna Post.	*Full*	Open antenna choke coil or connection.	
G1R	*Full*	Open connection.	
P of R. F. Sockets.	*None*	No. 1, 2, 3 R.F.T. primary circuit grounded.	Or shorted R.F. plate circuit bypass condenser. (Unsolder lead and test condenser separately.)
PD	*None*	No. 1 A.F.T. primary circuit grounded.	Or shorted phone condenser. (Unsolder lead and test condenser separately.)
P1A	*None*	No. 2 A.F.T. primary circuit grounded.	Inspect transformer connections.
G2R	*Partial*	None—Open secondary No. 1 R.F.T. or open grid resistor.	Full—Shorted grid resistor.
G3R	*Partial*	None—Open secondary No. 2 R.F.T. or open grid resistor.	Full—Shorted grid resistor.
GD	*None*	Shorted detector grid condenser.	Mounted on back of last var. cond.
G1A	*Partial*	None—Open secondary No. 1 A.F.T.	Full—Shorted secondary.
Stator of Detector Variable Condenser.	*Full*	Open secondary No. 3 R.F.T.	
RED to			
+F of All Sockets.	*Full*	Open positive filament circuit.	
Black	*Nearly Full*	None—Open detector grid bias resistance.	Full—Shorted bias resistor or grounded +F circuit.
WHITE to			
P of R.F. Sockets.	*Full*	Open primary No. 1, 2, 3 R.F.T.	
P1A	*Partial*	Open primary No. 1 A.F.T.	Full—Shorted primary.
YELLOW to			
PD	*Partial*	None—Open primary No. 1 A.F.T.	Full—Shorted primary.
BROWN to			
Speaker Post No. 2.	*Full*	Open connection.	
OTHER TESTS			
—C Lead (Green-Yellow Tracer) to G1A	*Partial*	None—Open secondary No. 2 A.F.T.	Full—Shorted secondary.
P2A to Speaker Post No. 1.	*Full*	Open connection	

Model 32 Receiving Set

General Description

The Model 32 is a seven-tube, single dial, battery type receiver, having four stages of radio frequency amplification, a tuned detector, and two stages of audio frequency amplification. The first R. F. amplifying tube is not tuned, being used as an antenna coupling tube for the purpose of preventing different sizes of antenna from disturbing the synchronism of the succeeding tuned circuits.

The filaments of the R. F. tubes are controlled by one rheostat. Another rheostat controls the detector filament, and a fixed resistance is connected in series with the two A. F. filaments.

The Model 32 may be recognized by its four double R. F. transformers and four moulded end-plate variable condensers.

Replacing Sub-Panel Assembly No. 8296

If one of the R. F. transformers or one of the variable condensers is defective, the entire sub-panel assembly must be replaced. This assembly consists of a metal frame, four moulded end-plate variable condensers, four double R. F. transformers, three grid resistors and a detector grid condenser, all mounted in place with pulleys and belts adjusted.

Remove dial and vernier knob. Unsolder leads from sub-panel assembly. Remove three screws in front panel at second variable condenser and five screws along the bottom. Remove two bolts holding fourth R. F. socket and remove by-pass condenser. (If by-pass condenser is of old style—brown color—replace with No. 8685.) Lift out old assembly.

Screw the replacement sub-panel assembly into position, without tightening screws, and replace the by-pass condenser, which is held by two bolts passing through the fourth R. F. socket. The edge of the condenser must not be caught under the bottom angle of the sub-panel frame. Tighten screws holding sub-panel. Solder connections exactly like original, assemble set and synchronize condensers. (See Section XI.)

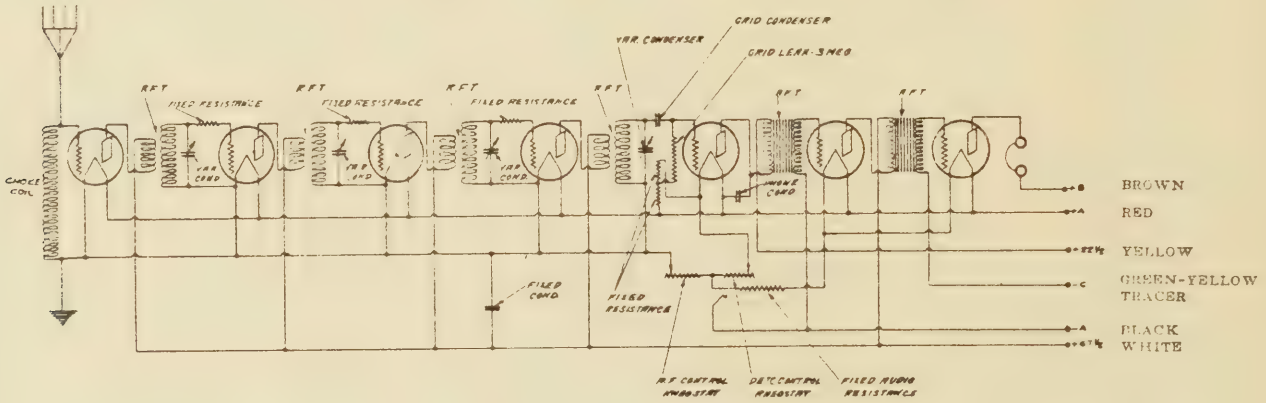


FIG. 43. WIRING DIAGRAM OF MODEL 32.

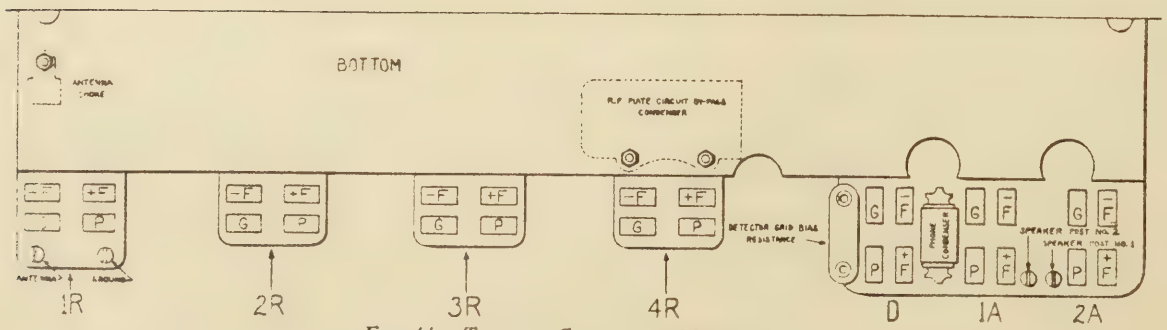


FIG. 44. TESTING CHART FOR MODEL 32.

Continuity Test Table—Model 32

(For Following Tests, Place Filament Switch "On" and Rheostats Barely "On")

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
			Examine cable for broken leads or short circuits. Repair or replace cable if necessary.
BLACK to			
—F of R.F. Sockets.	*Full*	Open in cable, connection, or R.F. rheo.	R.F. rheostat at left.
—FD	*Full*	Open connection or detector rheostat.	Detector rheostat at right.
—F of A.F. Sockets.	*Full*	Open connection or A.F. fil. fixed resistance.	A.F. resistance—green insulated wire from rheostat assembly to —F1A.
Ground Post.	*Full*	Open ground connection.	
Antenna Post.	*Full*	Open antenna choke coil or connection.	
G1R	*Full*	Open connection.	
P1R, P2R, P3R, P4R	*None*	No. 1, 2, 3, 4 R.F.T. pri. circuit grounded.	Or shorted R.F. by-pass condenser.
PD	*None*	No. 1 A.F.T. primary circuit grounded.	Or shorted phone condenser.
P1A	*None*	No. 2 A.F.T. primary circuit grounded	
Red	*Nearly Full*	None—Open detector grid bias resistance.	Full—Shorted bias or grounded positive filament circuit.
G2R, G3R, G4R	*Nearly Full*	None—Open secondary No. 1, 2, 3 R.F.T. or open No. 1, 2, 3 grid resistance.	Full—Shorted grid resistor. (Resistors mounted on back of R.F. variable condensers).
Stator of Detector Variable Condenser.	*Full*	Open secondary No. 4 R.F.T.	
G1A	*Partial*	None—Open secondary No. 1 A.F.T.	Full—Shorted secondary.
RED to			
+F of All Sockets.	*Full*	Open in cable or connection.	
WHITE to			
Plate of Each R.F. Socket.	*Full*	Open primary No. 1, 2, 3, 4 R.F.T.	
P1A	*Partial*	None—Open primary No. 2 A.F.T.	Full—Shorted primary.
YELLOW to			
PD	*Partial*	None—Open primary No. 1 A.F.T.	Full—Shorted primary.
BROWN to			
Speaker Post No. 2.	*Full*	Open in cable or connection.	
OTHER TESTS			
P2A to Speaker Post No. 1.	*Full*	Open connection.	
Green-Yellow Tracer to G2A	*Partial*	None—Open secondary No. 2 A.F.T.	Full—Shorted secondary.

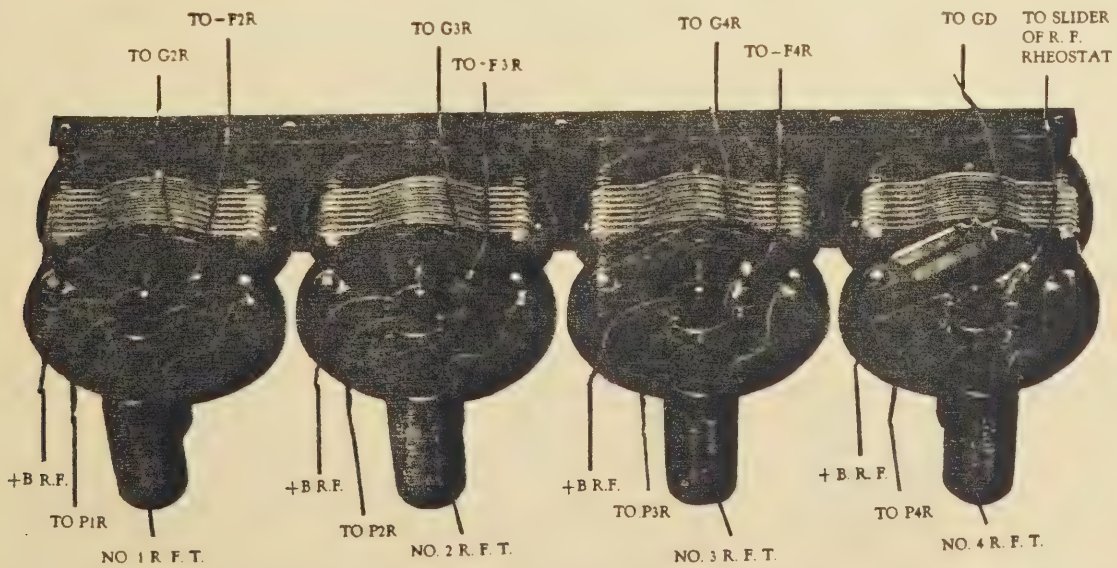


FIG. 45. VIEW OF SUB-PANEL ASSEMBLY MODEL 32, SHOWING WHERE EACH LEAD IS TO BE CONNECTED.

Models 33 and 49 Sets

General Description

The Model 33 is a six-tube, single-dial, battery-type receiver, having three stages of tuned radio frequency amplification, a tuned detector, and two stages of audio frequency amplification. The first variable condenser, tuning the secondary of the antenna transformer, has an extra independently variable plate controlled by a small knob at the left (antenna adjustment knob). This compensates for different size of antenna and makes it possible to maintain synchronism between this circuit and the other three tuned circuits.

The three R. F. filaments are controlled by one rheostat, the detector filament by another rheostat, and a fixed resistance is connected in series with the two A. F. filaments.

Model 49 is similar to Model 33, but has a gold-finished panel.

Removing Chassis from Panel—Loosen set screws in antenna adjustment knob and in the tuning dial. Remove vernier knob, tuning dial, and antenna adjustment knob. Remove six screws, three in a row at each end of the vertical side of the metal frame. Remove one screw near the center of the vertical side of metal frame. The panel may then be lifted clear of the chassis, taking care not to break the connections from rheostat assembly. (In removing set from cabinet it is sometimes necessary to slide the set out toward the left in order that the by-pass condenser will come at a place where the bottom wood strip, which holds panel screws, is cut away.)

Replacing Variable Condensers

If one of the variable condensers is defective, replace entire group of four. Part No. 9190. Use pulleys and belts of original group.

Procedure: Loosen twelve screws holding variable condensers to metal frame. Note how pulleys and belts are arranged and then remove them. Replace one condenser at a time. Do not mix up the old condensers with the replacements.

Remove the double R. F. transformers which are mounted on backs of variable condensers (do not unsolder transformer leads), at the same time removing the grid resistors, the grid condenser and the lugs of secondary leads, which are held to the condensers by the same nuts that hold the R. F. transformer brackets.

Remove the three screws holding first condenser, lift out the condenser and put in replacement without tightening screws. Mount the first R. F. transformer, the first grid resistor and the secondary lead lug, on the two bolts on back of the condenser. Make certain that the axes or long sides of the transformer coils are vertical. This may be checked by seeing that the sides of coils are parallel to the vertical metal strip on the back of the condenser. (Continued on page 40.)

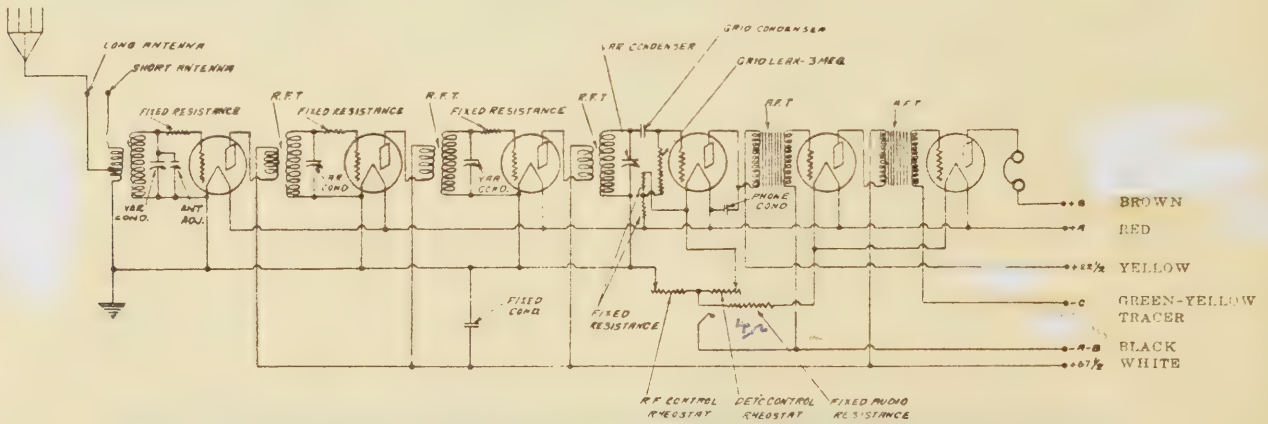


FIG. 46. WIRING DIAGRAM—MODELS 33 AND 49.

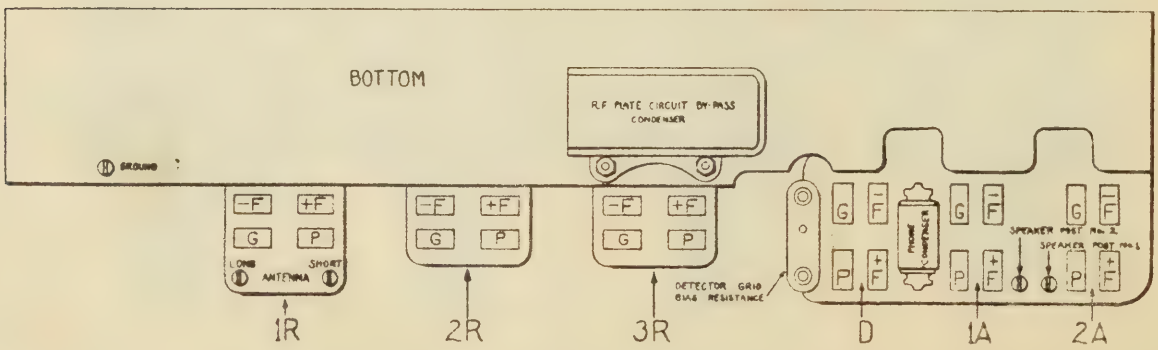


FIG. 47. TESTING CHART—MODELS 33 AND 49.

Continuity Test Table—Models 33 and 49

(For Following Tests, Place Filament Switch "On" and Rheostats Barely "On")

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
			Examine cable for open leads, broken connections and short circuits. Repair or replace cable if necessary.
BLACK to			
—F of R.F. Sockets.	*Full*	Open R.F. filament rheostat or connection.	R.F. rheostat at left.
—F of A.F. Sockets.	*Full*	Open A.F. fil. fixed resis. or wiring.	Fixed A.F. filament resistance is green insulated wire between rheo. assembly and —F1A.
—FD	*Full*	Open detector rheostat or connection.	Detector rheostat at right.
Ground Post.	*Full*	Open connection.	
Each Antenna Post.	*Full*	Open primary of antenna transformer.	
G1R	*Partial*	None—Open secondary antenna transformer or open grid resistor.	Full—Shorted grid circuit or shorted grid resistor.
P1R, P2R, P3R	*None*	No. 1, 2, 3 R.F.T. primary circuit grounded.	Or shorted R.F. plate circuit by-pass condenser. (Unsolder condenser lead and test condenser separately.)
PD	*None*	No. 1 A.F.T. primary circuit grounded.	Or shorted phone condenser. (Unsolder condenser lead and test condenser separately.)
P1A	*None*	No. 2 A.F.T. primary circuit grounded.	Inspect transformer connections.
G2R	*Partial*	None—Open secondary No. 1 R.F.T. or open grid resistor.	Full—Shorted grid circuit or shorted grid resistor.
G3R	*Partial*	None—Open secondary No. 2 R.F.T. or open grid resistor	Full—Shorted secondary circuit or grid resistor.
G1A	*Partial*	None—Open secondary No. 1 A.F.T.	Full—Shorted secondary.
Stator of Detector Variable Condenser.	*Full*	Open secondary of last (No. 3) R.F.T.	
RED to			
+F of All Sockets.	*Full*	Open positive filament circuit.	
Black.	*Nearly Full*	None—Open detector grid bias resistance.	Full—Shorted bias resistance or grounded +F circuit.
WHITE to			
P of R.F. Sockets.	*Full*	Open primary No. 1, 2, 3 R.F.T.	
P1A	*Partial*	None—Open primary No. 2 A.F.T.	Full—Shorted primary.
YELLOW to			
PD	*Partial*	None—Open primary No. 1 A.F.T.	Full—Shorted primary.
BROWN to			
Speaker Post No. 2.	*Full*	Open cable lead or connection.	
OTHER TESTS			
P2A to Speaker Post No. 1.	*Full*	Open connection.	
—C Lead Green-Yellow Tracer to G2A	*Partial*	None—Open secondary No. 2 A.F.T.	Full—Shorted secondary.

Repeat procedure with each condenser and when all four are in place, put on the pulleys and belts, adjust belt tension and synchronize condensers. (See Section XI.)

Replacing R. F. Transformers

If one of the double R. F. transformers is defective, replace entire group of four. Part No. 9220.

In replacing double R. F. transformers, substitute one transformer at a time, mounting and connecting the replacement exactly like the original. Do not mix up the old coils with the replacements. Remove two nuts on back of first variable condenser which hold R. F. transformer brackets, unsolder transformer connections and remove old transformer. Put replacement transformer in position, seeing that the grid resistor and lug of secondary lead are replaced properly, and tighten the two nuts. The transformer angle brackets must be arranged so that the axis or long sides of the coil are vertical. This may be checked by seeing that the long sides of the coils are parallel to the vertical metal strip on the back of the variable condenser. Solder leads exactly like the original. Repeat procedure with each R. F. transformer.

The antenna transformer may be identified by its five leads; other R. F. transformers have four leads.

No. 1 R. F. T. has one green lead.
No. 2 R. F. T. has one yellow lead.
No. 3 R. F. T. has one blue lead.

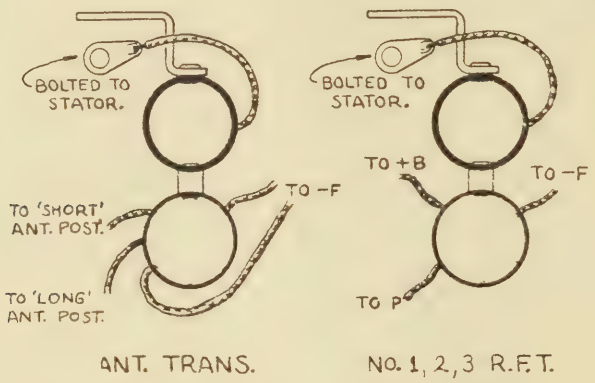


Fig. 48. Sketch Showing How Leads From Antenna Transformer and From R.F. Transformers Are To Be Connected.

Model 50 Set

General Description

The Model 50 employs seven tubes, having four stages of radio frequency amplification, a detector, and two stages of audio frequency amplification. The four stages of radio frequency are not tuned, the R. F. transformers being of a special air-core design, which covers the entire wave-length band efficiently. These transformers therefore do not have variable condensers connected across their secondaries.

A special method of tuning is used to couple the antenna circuit to the grid circuit of the first R. F. stage. This consists of a series or cascade of three tuned circuits loosely coupled together, tuned by three condensers geared together by belts similar to those used in the tuned R. F. sets. (See schematic diagram.)

The distance between the three tuning coils and the angle at which they are suspended relatively to each other, is worked out to give a selective filter between antenna and the first R. F. stage. As in the Model 33, two posts are provided for connection to the antenna coil, and one plate of the condenser across the secondary of the antenna circuit is separately adjustable, in order to compensate for different antenna lengths which may be used.

The selected signal which is tuned in by the station dial is passed through the four R. F. stages where it is amplified to considerable volume before reaching the detector. The detector and audio portion of this set is practically the same as in other Atwater Kent receivers.

In order to obtain selectivity and stability of operation, the various R. F. sections of the set (tuning stage, first and second R. F. stages, third and fourth R. F. stages and detector), are separately encased in grounded metal containers, and the entire set is enclosed in a single grounded metal housing that fits in the mahogany cabinet.

This shielding helps prevent interaction between the fields of the various coils, but its main purpose is to prevent any signal from outside entering the amplifying stages direct, without having passed through the antenna tuning system. The elimination of undesired signals is thereby readily obtained, and external "pick-up" reduced to a minimum. Pick-up of signals by the battery cable is eliminated by a by-pass condenser connected across the "A" battery circuit at the upper end of cable, and and by a choke-coil in the R. F. positive "B" voltage lead, the terminals of this choke being shunted to the ground by two additional by-pass condensers. (See schematic diagram, Fig. 50.)

One rheostat (left-hand knob) controls the filaments of the four R. F. tubes, a separate rheostat (right-hand knob) controls the detector filament, and a fixed resistor is connected in series with the filaments of the two A. F. tubes.

Removing Set from Mahogany Cabinet

Remove set from wood cabinet by taking out four round-head wood screws which hold bottom of metal case to the wood cabinet. Then take wood screws out of front panel, and slide metal case out of cabinet.

Removing Set from Metal Case

Remove the fourteen filister-head screws along bottom and sides and one screw at center top which hold the set to the metal case. The set, with its attached cable, may then be slid out of the metal case.

Testing Model 50

The continuity tests may be applied to Model 50 set without removing the set from its mahogany cabinet. The test prongs (in the voltmeter-battery testing circuit) should be long and sufficiently narrow at the pointed ends to fit down through the socket holes and make connection with the socket contacts. A test table and photographic chart for the Model 50 appear on the following pages.

Replacements

After applying the continuity tests and determining the source of trouble, the set may be removed from its metal case and repaired. In making replacements, first carefully study the manner in which the defective material is mounted and connected, then substitute the replacement, mounting and connecting it in exactly the same way as the original.

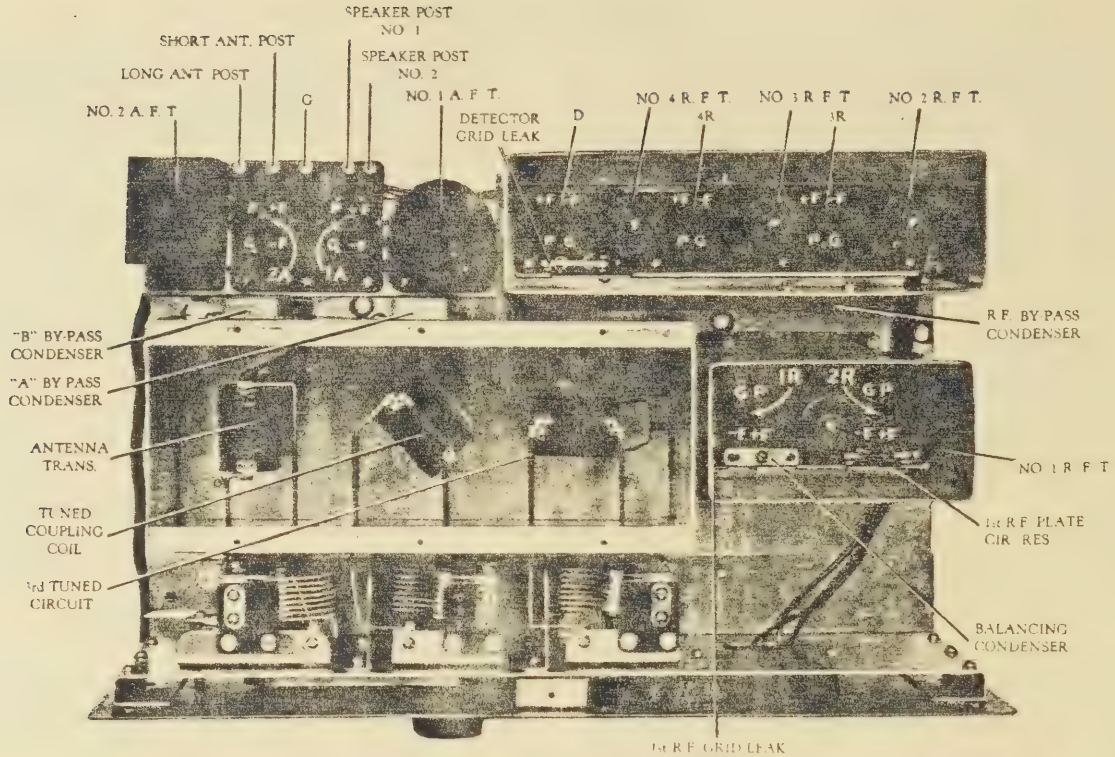


FIG. 49. TESTING CHART FOR MODEL 50.

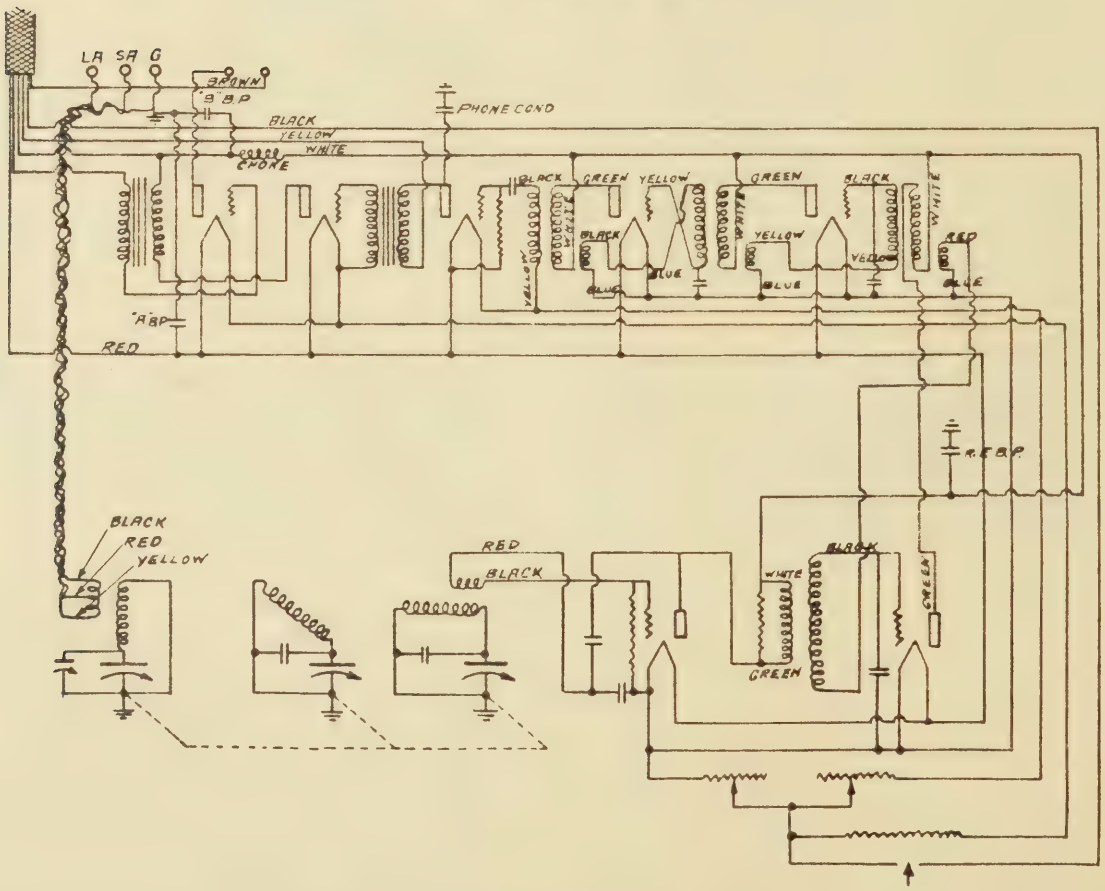


FIG. 50. WIRING DIAGRAM OF MODEL 50.

NOTE.—Black lead (—F) is grounded—not shown in diagram. Most of Model 50 Sets also have an R.F. choke between plate of second audio tube and speaker post No. 1.

Continuity Test Table—Model 50

(Colors Refer to Cable Leads, Unless Otherwise Specified)

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
(For following tests place Filament Switch "on" and Rheostats barely "on.")			Examine cable for open leads, broken connections and short circuits. Repair or replace cable if necessary.
BLACK to			
—F of each R.F. socket.	*Full*	Open in cable, wiring or R.F. rheostat.	R.F. rheostat at left.
—FD	*Full*	Open connection or open det. rheostat.	Detector rheostat at right.
—F of each A.F. socket.	*Full*	Open con. or open A.F. fil. fixed resis.	
Ground Post.	*Full*	Open ground connection.	
Each Antenna Post	*Full*	Open antenna coil or connection.	
Stator of each Variable Condenser.	*Full*	Open sec. ant. trans., or open tuned coupling coil, or open primary 3rd tuned circuit.	Located in container at rear of variable condensers.
Plate of each R.F. socket.	*None*	Nos. 1, 2, 3, 4 R.F.T. pri. circuit grounded.	Or shorted "B" or R.F by-pass condenser, or shorted balancing condenser.
PD	*None*	No. 1 A.F.T. primary circuit grounded.	Or shorted phone condenser.
Red	*None*	Grounded positive filament circuit or shorted "A" by-pass condenser.	
P1A	*None*	No. 2 A.F.T. primary circuit grounded.	
G2R	*Nearly Full*	None—Open secondary No. 1 R.F.T. or open auxiliary coil No. 2 R.F.T.	Full—Shorted secondary or shorted fixed secondary condenser.
G3R	*Nearly Full*	None—Open secondary No. 2 R.F.T. or open auxiliary coil No. 3 R.F.T.	Full—Shorted secondary or shorted fixed secondary condenser.
G4R	*Nearly Full*	None—Open secondary No. 3 R.F.T. or open auxiliary coil No. 4 R.F.T.	Full—Shorted secondary or shorted fixed secondary condenser.
GD	*None*	Shorted detector grid condenser.	
Black sec. lead of No. 4. R.F.T.	*Nearly Full*	Open secondary No. 4 R.F.T.	Full—Shorted secondary.
G1A	*Partial*	None—Open secondary No. 1 A.F.T.	Full—Shorted sec. No. 1 A.F.T.
G2A	*None*	Grounded secondary circuit No. 2 A.F.T.	
RED to +F of all sockets.	*Full*	Open cable lead or connection.	
WHITE to Plate of each R.F. socket.	*Nearly Full*	None—Open cable lead or primary No. 1, 2, 3, or 4 R.F.T., or open R.F. choke coil.	
P1A	*Partial*	None—Open primary No. 2 A.F.T.	Full—Shorted primary.
YELLOW to PD	*Partial*	None—Open pri. No. 1 A.F.T.	Full—Shorted primary.
BROWN to Speaker Post No. 2	*Full*	Open cable lead or connection.	
OTHER TESTS			
P2A to Speaker Post No. 1	*Nearly Full*	Open connection or open output R.F. choke.	
Green-Yellow Tracer to G2A	*Partial*	None—Open cable lead or sec. No. 2 A.F.T.	Full—Shorted secondary.
G1R to Center Screw of Balancing Condenser.	*Nearly Full*	None—Open secondary 3rd tuned circuit.	
Center Screw of Balancing Condenser to —F1R.	*None*	Shorted grid section of balancing condenser.	

Model 36 Set

General Description

Model 36 is a six-tube, single-dial receiver designed for A. C. tubes, with filament, plate and grid voltages supplied by type "Y" Atwater Kent power unit.

Model 36 has three stages of tuned radio frequency amplification, a tuned detector circuit and two stages of audio frequency amplification, the second audio stage being designed for a power tube. The R. F. transformers are of the double-coil type. The first variable condenser has an independently variable plate which is adjustable to compensate for the effects of different antenna sizes.

Connections from the set to power unit are made by means of a heavy cable terminating in a cable connection panel which fits over the corresponding terminals on the power unit. The power unit is provided with a cord and plug for insertion in the A. C. lighting socket. The power unit is designed for use on standard house supply of electricity, 110 volts, 60 cycle alternating current.

The volume of reception in the Model 36 is controlled by means of a double resistance coil, so connected as to by-pass equally from the plates of the first two R. F. tubes, any desired amount of energy, thereby giving a smooth and accurate control of volume. In a few of the earlier sets, the volume was controlled by varying a series capacity in the plate circuit of the first R. F. tube, by means of a tap-switch controlling a group of fixed condensers connected in series.

The correct grid bias voltage is supplied to the various tubes by grounding all the grid returns and then connecting the ground to the filament circuit of the various tubes, through resistances of the correct value in each case. Since the negative of the "B" voltage output of the rectifier is grounded, and the filament voltage relatively positive, the resulting "C" voltage secured on the grid from the ground will be negative. It should be noted(see schematic diagram) that since an A. C. voltage is being applied to each side of the filament of the tube, it is necessary in order to get a constant voltage value from the filament to obtain a connection from the center of the filament. This is done by taking a tap-off at the mid-point of a resistance shunted across the filament terminals. The lead from this tap is connected through a resistance of the correct value in each case to the minus B or ground, to which all grid returns are connected.

A protective choke and condenser are used to keep the high-voltage direct current supplied to the plate of the last audio tube, from passing through the magnet windings of the speaker. This also improves the quality of reception.

The "B" power supply incorporated in the "Y" power unit is very much the same as the regular Model "R" "B" power unit, except that a standard filament type rectifier tube is used. The filament of this tube performs the same function as the grid electrode in the A. K. rectifier tube, a connection leading out from the filament, through the required chokes, to the positive "B" voltage supply terminal. (See Section VII.)

The starting and stopping of the set is accomplished by a toggle switch connected in series with the primary of the A. C. transformer, which is the same as being in series with the 110 volt A. C. house line.

Information about A. C. sets in general and power units is given in Section I.

Diagrams and test tables for Model 36 are given on pages 46 and 47. The "Y" type power unit is described on pages 48, 49, 50 and 51.

Removing Set from Cabinet and Panel

Place set on table with panel facing up, remove wood screws from around edges of panel and then lift set out vertically, inserting the finger nails under edge of panel. Do not lift by dial or other parts. See that cable can pass freely through hole in back of cabinet as set is being lifted out. It will be necessary to slide the chassis slightly to the left before it can be lifted out, to allow the by-pass condenser to clear.

The chassis is attached to the panel by seven screws, three in a row at each end and one near the centre of the vertical side of the metal frame. Remove these screws, remove the dial, the vernier knob and the antenna adjustment knob (at left end). The panel may then be lifted clear of the chassis. If it is desired to separate the panel from the chassis, unsolder the two cable connections to toggle switch, and also, in the case of old style condenser-type volume controls, unsolder the leads from volume control.

Replacing Variable Condensers

If one variable condenser is defective, replace entire group of four condensers. Part No. 9190. Use pulleys and belts of original group.

Procedure: Remove chassis from panel. Loosen twelve screws holding variable condensers to metal frame. Note how pulleys and belts are arranged and then remove them. Replace one condenser at a time. Do not mix the old condensers with the replacements.

Remove the double R. F. transformers which are mounted on backs of variable condensers (do not unsolder transformer leads), at the same time removing the grid resistors, the grid condenser and the lugs of secondary leads which are held to the condensers by the same nuts that hold the R. F. transformer brackets.

Remove the three screws holding first condenser, lift out the condenser and put in replacement without tightening screws. Mount the first R. F. transformer, the first grid resistor and the secondary lead lug, on the two bolts on back of the condenser. Make certain that the axes or long sides of the transformer coils are vertical. This may be checked by seeing that the sides of coils are parallel to the vertical metal strip on the back of the condenser.

Repeat procedure with each condenser and, when all four are in place, put on the pulleys and belts, adjust belt tension and synchronize condensers. (See Section XI.)

Replacing R. F. Transformers

If one double R. F. transformer is defective, replace entire group of four transformers. Part No. 9590.

The antenna transformer may be identified by its white lead.

No. 1 R. F. T. has one green lead.
No. 2 R. F. T. has one yellow lead.
No. 3 R. F. T. has one blue lead.

In replacing double R. F. transformers, substitute one transformer at a time, mounting and connecting the replacement exactly like the original. Do not mix up the old coils with the replacements.

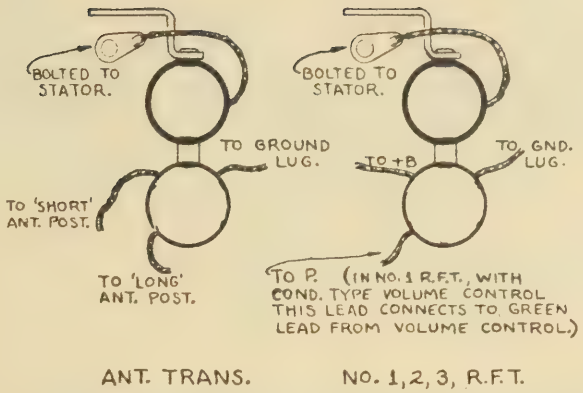


Fig. 51. Sketch Showing Connections From Antenna Transformer and From R. F. Transformers.

Remove two nuts on back of the first variable condenser which hold R. F. transformer brackets, unsolder transformer connections and remove old transformer. Put replacement transformer in position, seeing that the grid resistor and lug of secondary lead are replaced properly, and tighten the two nuts. The transformer angle brackets must be arranged so that the axis or long sides of the coil are vertical. This may be checked by seeing that the long sides of the coils are parallel to the vertical metal strip across the back of the variable condenser. Solder leads exactly like the original. Repeat procedure with each R. F. transformer.

Diagrams and Test Table for Model 36 are given on Pages 46 and 47.

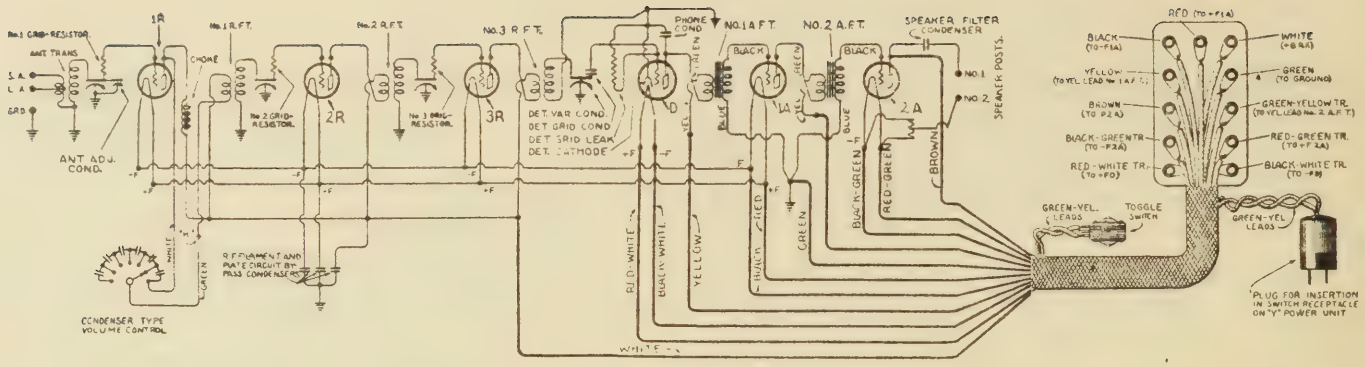


FIG. 52. WIRING DIAGRAM OF MODEL 36 WITH CONDENSER TYPE VOLUME CONTROL AND CABLE CONNECTION PANEL FOR EARLY MODEL "Y" POWER UNIT. (Note that the +B 1st A.F. cable lead is green with a yellow tracer. In some Model 36 sets, and in all other Atwater Kent A.C. receivers, a black-red tracer is used for this connection.)

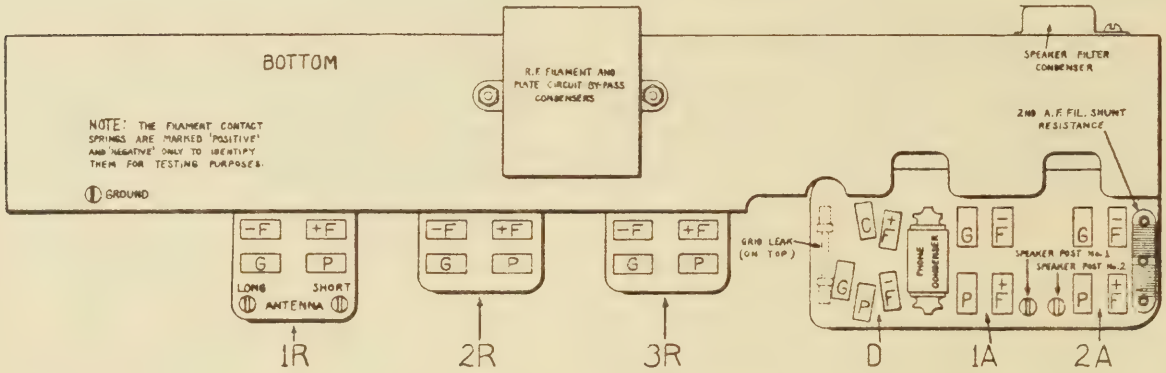


FIG. 53. TEST CHART FOR MODEL 36.

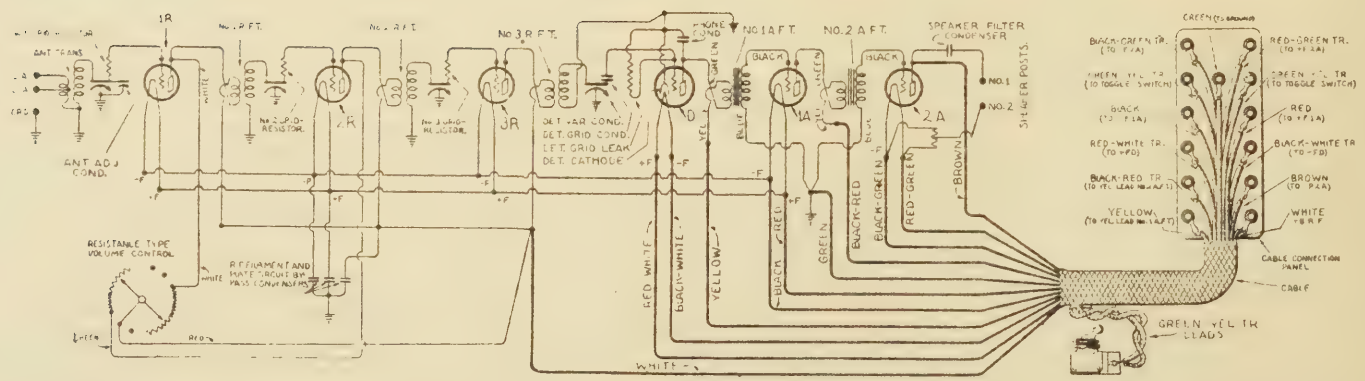


FIG. 54. WIRING DIAGRAM OF MODEL 36 WITH RESISTANCE TYPE VOLUME CONTROL AND CABLE CONNECTION PANEL FOR LATER MODEL "Y" POWER UNIT. (Note that the red and the black cable leads feed the R.F. filaments as well as the 1st A.F. filament. In some Model 36 sets the +B 1st A.F. cable lead is green with a yellow tracer.)

Continuity Test Table—Model 36

(Colors Refer to Cable Leads)

For Following Tests Remove Cable Panel from Power Unit

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
Red-Green Tr. to +F2A Black-Green Tracer to —F2A Red-White Tr. to +FD Black-White Tracer to —FD Red to +F1A Black to —F1A Green to Ground Post. Brown to P2A	*Full*	Open in cable or connection.	Examine soldered connections at cable connection panel and set.
GREEN to			
P1A	*None*	Grounded 1st A.F. plate circuit.	
PD	*None*	Grounded detector plate circuit.	Or shorted phone condenser.
P3R	*None*	Grounded R.F. plate circuit.	Or shorted R. F. by-pass condenser.
+F3R, —F3R	*None*	Grounded R.F. 1st A.F. filament circuit.	Or shorted R. F. by-pass condenser.
+FD, —FD	*None*	Grounded detector filament circuit.	
+F2A, —F2A	*None*	Grounded 2nd A.F. filament circuit.	
G1R, G2R, G3R	*Partial*	None—Open grid res. or open sec. of ant. transformer or No. 1 or 2 R.F.T.	Full—Shorted grid resistor. Test resistors separately. (Mounted on back of R.F. variable condensers.)
G1A	*Partial*	None—Open secondary No. 1 A.F.T.	Full—Shorted grid circuit.
G2A	*Partial*	None—Open secondary No. 2 A.F.T.	Full—Shorted grid circuit.
Stator of Detector Variable Condenser.	*Full*	Open secondary last R.F.T.	
CD	*Full*	Open cathode lead.	
WHITE to			
P1R, P2R, P3R (Volume Control Turned Full Right.)	*Full*	Open primary No. 1, 2, 3 R.F.T.	Or open plate circuit choke in cond.-choke type volume control.
YELLOW to			
PD	*Partial*	None—Open primary No. 1 A.F.T.	Full—Shorted primary.
+B 1st A.F. Lead (Black-Red, or Green-Yellow) to P1A	*Partial*	None—Open primary No. 2 A.F.T.	Full—Shorted primary.
OTHER TESTS			
GD to Stator Last Variable Condenser.	*None*	Shorted grid condenser.	Mounted on back of detector variable condenser.
P2A to Speaker Post No. 1.	*None*	Shorted speaker filter condenser.	
Green to each Ant. Post.	*Full*	Open primary antenna transformer.	
Speaker Post No. 2 to —F2A, +F2A	*Full*	Open connection or open 2nd A.F. filament shunt resistance.	
Across Switch Plug Contacts. (Before Serial No. 2,610,000.) (Toggle Switch "On.")	*Full*	Open in switch leads or connection.	No reading with toggle switch "off."
Across Green-Yellow Tracer Leads on Cable Connection Panel. (After Serial No. 2,610,000.) (Toggle Switch "On.")	*Full*	Open in switch leads or connections.	No reading with toggle switch "off."
Res. Type Vol. Control. P1R to P2R (Turn Knob.)	*Nearly Full*	Defective resistance winding or slider.	No reading with knob turned full right.
Condenser-Choke Type Volume Control. White to Point K (on Primary No. 1 R.F.T.)	*Full*	Open primary No. 1 R.F.T.	
P1R to Point K (Unsolder One Choke Lead.)	*None*	Shorted condenser in volume control.	Test with volume control switch on each tap. Resolder lead.

Model "Y" Power Units below Serial No. 260,000

(Used with Model 36 Sets below Serial No. 2,610,000)

General Description

Model "Y," below Serial No. 260,000, is a complete power unit enclosed in a metal case separate from the receiving set. It is designed to operate from 110 volt, 60 cycle, alternating current and furnish complete filament, plate, and grid voltages to Model 36 sets bearing serial numbers below 2,610,000. (Model 36 receiving sets above Serial No. 2,610,000 used a later type of "Y" power unit which is described on the next pages.)

Information about Atwater Kent power units is given in the first section of this manual.

In Model "Y" power units below Serial No. 260,000, a potentiometer is connected across the R. F. first A. F. filament circuit. It is to be adjusted with the slider at approximately the center point for least hum in reception.

A receptacle in series with one side of the 110 volt A. C. line is mounted on the front of the unit case. A toggle switch on the panel of the set is connected to this receptacle through two green-yellow tracer leads in the set cable. The leads are connected to a plug for insertion in the receptacle. The toggle switch on the set turns the 110 volt A. C. supply on or off.

A regulating or "load" resistance in the unit is connected across the B+ and B— output terminals. This resistance is wound on a form on which two grid bias resistances are also wound.

The unit has four separate metal containers, one for the power transformer, one for the filter chokes, a third for the fixed condensers and a fourth for the speaker (output) choke and for a by-pass condenser that is connected to the first A. F. plate circuit resistance.

Removing Power Unit from Case

Remove the four screws around cover, the four felt-headed feet and the single round-head machine screw at the bottom of the case. Remove the three screws holding potentiometer and the four screws at corners of the panel assembly. Unsolder connections to switch receptacle and unsolder the connection between one line of 110 volt cable and one lead from the primary of the power transformer. Unscrew the hexagon nut from back of receptacle and remove receptacle. Pull the 110 volt cable up and take out the knot. Pull cable out of

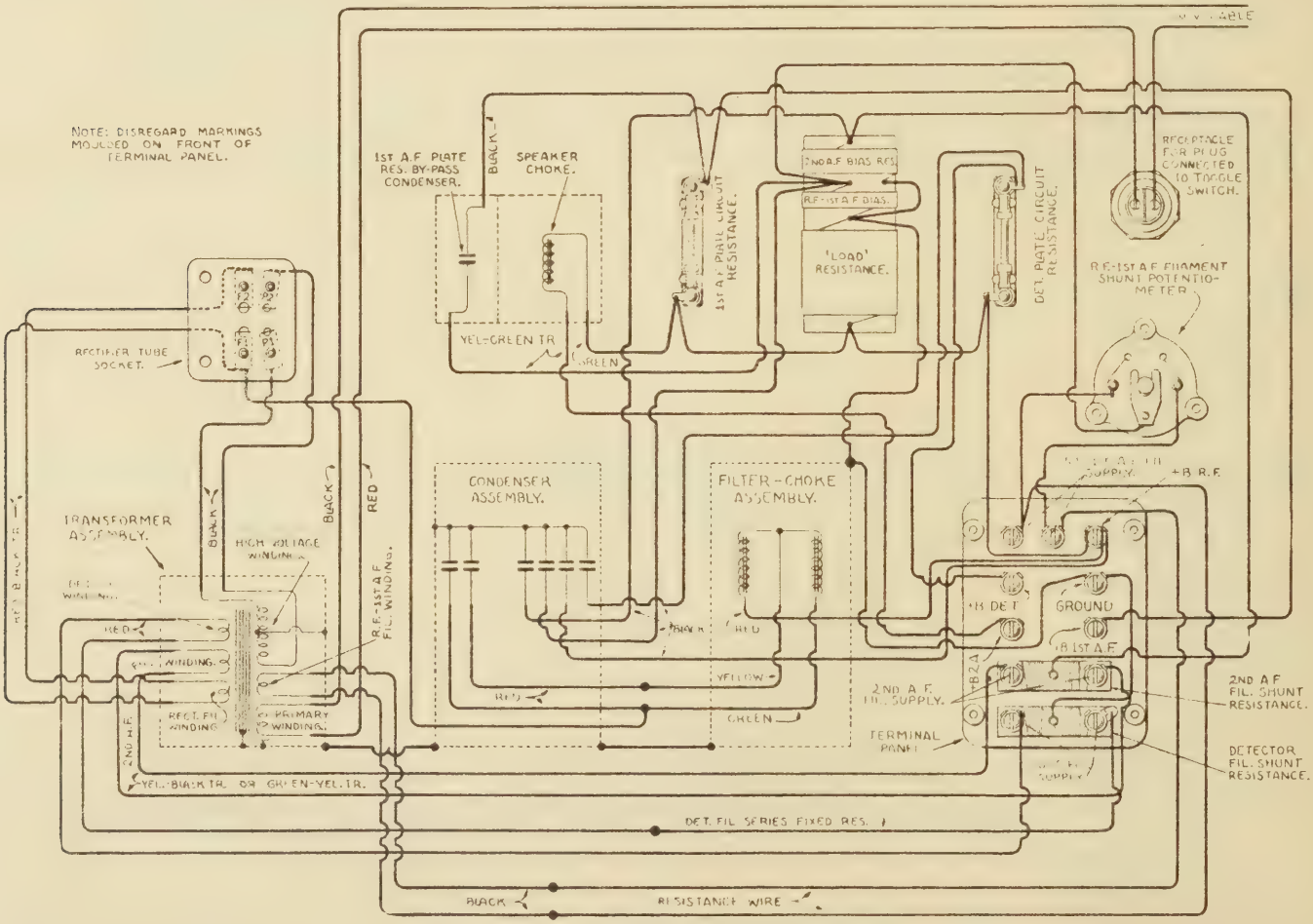


FIG. 55. WIRING DIAGRAM OF "Y" POWER UNIT BELOW SERIAL NO. 260,000. (The two leads to any one secondary winding may be reversed without affecting results.) This diagram shows the **APPROXIMATE** relative position of leads from the sealed containers.

case and remove soft rubber bushing through which cable enters unit. Push the potentiometer and panel assembly back so the unit may be withdrawn from the case. Leads from the different sections come out on one side; rest the case on opposite side and carefully draw out the unit.

A brief inspection will show that loosening the nuts on the three long bolts releases the various sections. Note how the flexible metal strips from each section are soldered together, and that the flexible metal strip at the top of the condenser section is laid under the heavy metal strip which clamps the choke and the condenser sections to the base.

Testing

Apply the continuity tests given in the table on this page. If the tests indicate that one section of the unit is defective, replace that section, connecting it exactly as the original.

When replacing the unit in its case make certain that all soldered joints on loose wires are insulated with tubing or with electrician's tape.

Continuity Test Table—"Y" Power Unit (Early Type)

TEST	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
Across 2nd A.F. Filament Supply.	*Full*	None—Open 2nd A.F. fil. winding and open 2nd A.F. filament shunt resistance.	Nearly Full—Open filament winding. (Unsolder one filament winding connection and test winding and filament shunt resistance separately.)
Across R.F.-1st A.F. Filament Supply.	*Full*	None—Open R.F.-1st A.F. fil. winding and open filament shunt potentiometer.	Nearly Full—Open filament winding. (Unsolder one filament winding connection and test winding and filament shunt resistance separately.)
Across Detector Filament Supply.	*Full*	None—Open det. fil. winding and open detector filament shunt resistance.	Nearly Full—Open filament winding. (Unsolder one filament winding connection and test winding and filament shunt resistance separately.)
From Ground to each Metal Container.	*Full*	Open ground connection.	
FROM +B R.F. to			
+B 2nd A.F.	*Partial*	None—Open speaker (output) choke.	Full—Shorted choke.
+B 1st A.F.	*Small*	None—Open 1st A.F. plate circuit resis.	
+B Detector.	*Very Small*	None—Open detector plate circuit resistance.	
Ground.	*Partial*	None—Open regulating resistance.	Full—Shorted regulating resistance, or shorted filter condenser.
F1 (on Rectifier Tube Socket.)	*Partial*	None—Open plate supply filter choke.	
FROM GROUND to			
+B 1st A.F.	*Small*	Full—Shorted by-pass condenser.	**(NOTE: If any of the condensers is thought to be defective, unsolder leads from the rest of the circuit and test each condenser separately. The plate supply filter chokes may be tested in the same manner.)**
+B Detector.	*Very Small*	Full—Shorted by-pass condenser.	
One Side of 2nd A.F. Filament Supply.	*Partial*	None—Open 2nd A.F. grid bias resistance.	Full—Shorted grid bias resistance or shorted by-pass condenser.
One Side of R.F.-1st A.F. Filament Supply.	*Partial*	None—Open R.F.-1st A.F. grid bias resis.	Full—Shorted grid bias resistance or shorted by-pass condenser.
One Side of Dector Filament Supply	*Full*	None—Open connection to center-tap of detector filament shunt resistance.	Examine connections under panel assembly.
P1, P2 (on Rectifier Tube Socket.)	*Nearly Full*	None—Open high voltage secondary winding or connections.	
Both Terminals of A.C. Plug.	*None*	Grounded primary of power transformer.	Inspect cable and primary leads for accidental grounds.
OTHER TESTS			
Across Terminals of A.C. Plug. (Short Circuit the Terminals of the Switch Receptacle.)	*Full*	Open primary circuit of power transformer.	
F1 to F2 (on Rectifier Tube Socket.)	*Full*	Open rectifier fil. winding or connection	

Model "Y" Power Units Above Serial No. 260,000

(Used with Model 36 Sets above Serial No. 2,610,000)

General Description

Model "Y," above Serial No. 260,000, is a complete power unit enclosed in a metal case separate from the receiving set. It is designed to operate from 110 volt alternating current and to furnish complete filament, plate, and grid voltages to Model 36 receivers bearing serial numbers above 2,610,000. (Model 36 sets below Serial No. 2,610,000 use the earlier type "Y" power unit which is described on the preceding pages.)

The panel assembly of the later type unit is mounted inside the metal case of the unit. This assembly contains terminals for connection to the set "cable connection panel," three center-tapped filament shunt resistances, two grid bias resistances, a resistance in series with the detector plate circuit and a resistance in series with the first A. F. plate circuit. Two of the terminals connect, through the set cable, to a toggle switch mounted on the panel of the set. This toggle switch turns the 110 volt A. C. supply on or off.

The unit has three metal containers, one for the power transformer, one for the filter and speaker choke, and one for the fixed condensers.

Removing Unit From Case

Remove the four felt-headed feet and the single round-head machine screw at the bottom of the cabinet. Leads from the various sections come out on one side; rest cabinet on opposite side and carefully draw out the unit. The various sections are held to the base by three long bolts and two heavy metal strips. The panel assembly is mounted on one of the metal strips by two bolts and nuts—one the ground terminal and the other at the center toward the opposite end of the panel assembly. Note how the flexible metal strips from the containers are soldered together and that the strip at the top of the condenser section is laid under the heavy metal strip which holds down the condenser and choke coil sections.

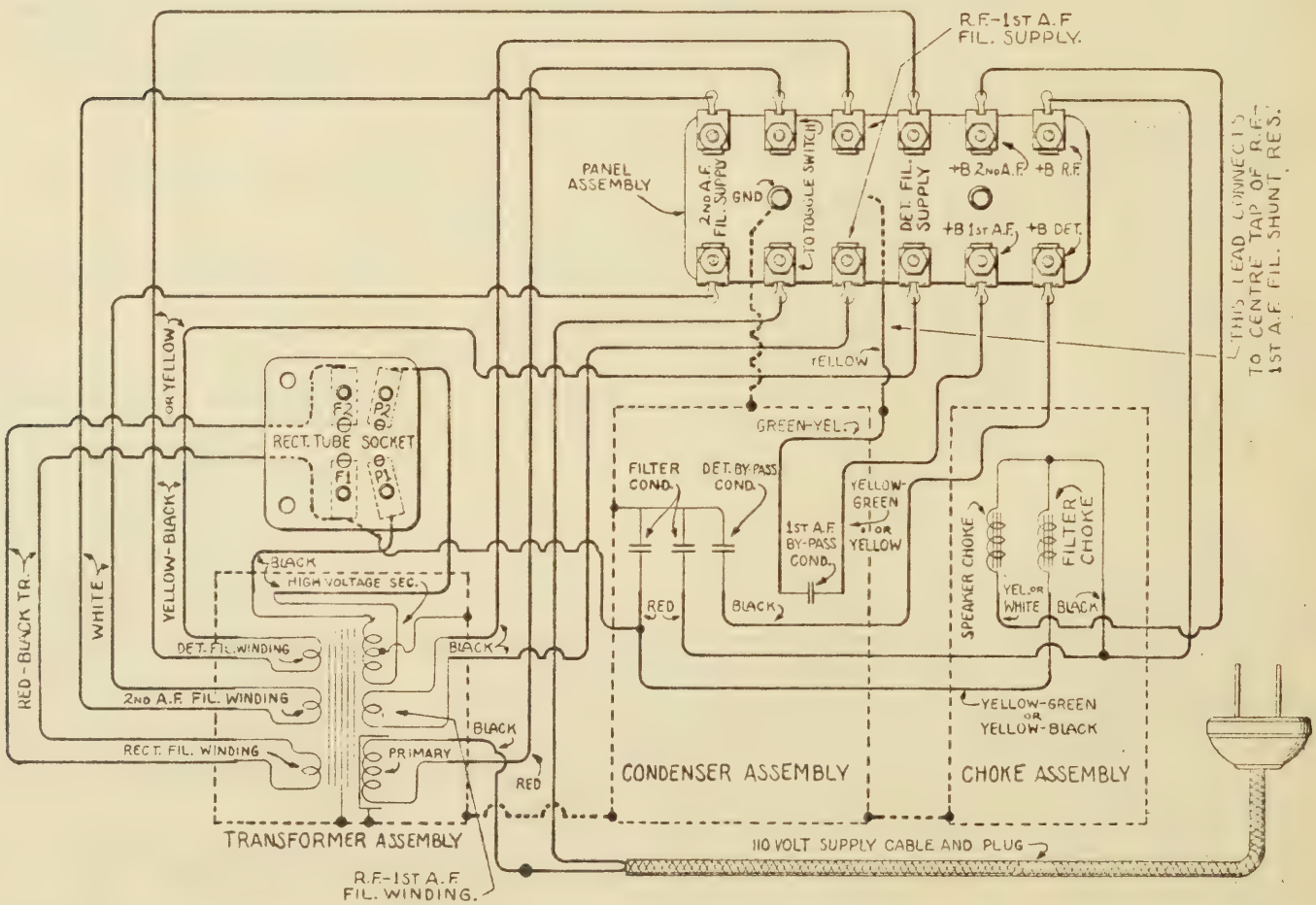


FIG. 56. WIRING DIAGRAM OF "Y" POWER UNIT ABOVE SERIAL NO. 260,000. (The connection to the ground terminal is made indirectly through a flexible metal strip. A rear view of the panel assembly is shown in the description of the power unit for Model 37 and 38 receivers. The above diagram shows the **APPROXIMATE** relative position of leads from the sealed containers.)

Testing

Apply the continuity tests given in the table on this page. If the tests indicate that one of the sections is defective, that section should be replaced, mounting and connecting the replacement exactly as the original.

When replacing the unit in its case, make certain that all soldered joints on loose wires are insulated with tubing or with electrician's tape.

Continuity Test Table—"Y" Power Unit (Later Type)

TEST	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
From Ground to Each Metal Container.	*Full*	Open ground connection.	
Across 2nd A.F. Filament Supply.	*Full*	None—Open 2nd A.F. fil. winding and open 2nd A.F. filament shunt resistance.	Nearly Full—Open filament winding. (Unsolder one filament winding connection and test winding and filament shunt resistance separately.)
Across R.F.-1st A.F. Filament Supply.	*Full*	None—Open R.F.-1st A.F. filament winding. and open filament shunt resistance.	Nearly Full—Open filament winding. (Unsolder one filament winding connection and test winding and filament shunt resistance separately.)
Across Detector Filament Supply.	*Full*	None—Open detector filament winding and open detector filament shunt resistance.	Nearly Full—Open filament winding. (Unsolder one filament winding connection and test winding and filament shunt resistance separately.)
FROM +B R.F. to			
+B 2nd A.F.	*Partial*	None—Open speaker output choke.	Full—Shorted speaker choke.
+B 1st A.F.	*Small*	None—Open 1st A.F. plate circuit resistance.	
+B Detector.	*Very Small*	None—Open detector plate circuit resistance.	
Ground.	*None*	Shorted filter condenser.	
F1 (on Rectifier Socket).	*Partial*	None—Open plate supply filter choke.	
FROM GROUND to			
+B 1st A.F.	*None*	Shorted by-pass condenser.	(NOTE: If either of the by-pass condensers is thought to be defective, unsolder its lead from the rest of the circuit and test the condenser separately.)
+B Detector.	*None*	Shorted by-pass condenser.	
One Side of 2nd A.F. Filament Supply.	*Partial*	None—Open 2nd A.F. grid bias resistance.	Full—Shorted grid bias resistance.
One Side of R.F.-1st A.F. Filament Supply.	*Partial*	None—Open R.F.-1st A.F. grid bias resis.	Full—Shorted grid bias resistance.
One Side of Detector Filament Supply.	*Full*	Open connection to center-tap of detector filament shunt resistance.	Examine connections under panel assembly.
P1, P2 (on Rectifier Tube Socket.)	*Nearly Full*	None—Open high voltage secondary winding or connections.	
Each Terminal of A.C. Plug.	*None*	Grounded primary of power transformer.	Examine primary connections for accidental grounds.
OTHER TESTS			
Across Terminals of A.C. Plug. (Short Circuit Toggle Switch Terminals on Panel Assembly.)	*Full*	Open primary power transformer or open leads.	
F1 to F2 (on Rectifier Tube Socket).	*Full*	Open rectifier fil. winding or connections.	

General Description

Model 37 is a six-tube, single-dial, A. C. type radio receiver with a complete power unit incorporated in the metal cabinet that houses the set. The power unit operates from 110 volt, 60 cycle, alternating current (special model for 25 cycle current) and supplies complete filament, plate and grid voltages to the set.

Model 37 has three stages of radio frequency amplification, the first stage acting as an untuned coupling tube, in order to eliminate the detuning effect of different antenna sizes, which would otherwise disturb synchronism of the three tuned circuits.

The volume control in the Model 37 consists of a variable resistance connected directly between the antenna and ground posts of the set. When the knob of this control is full "on" the slider passes off the coil, cutting the latter out of the circuit entirely. As the control is turned back, less and less resistance is included between the aerial and ground, so that more and more of the energy of the incoming signal is shunted to the ground instead of passing into the set—thereby the volume is reduced as desired.

Removing Chassis from Cabinet

First remove cover from power unit by taking out the two screws at its lower outside ends, and four screws at bottom of front. Lift cover off vertically, exposing set cable connection panel. Remove nuts from bolts which pass through holes in cable connection panel and lift connection panel off, releasing cable from power unit.

Take out the six screws, three in a row at each end, which clamp the metal frame of chassis to brackets at inside front of cabinet. Remove vernier knob and

(Continued on page 54.)

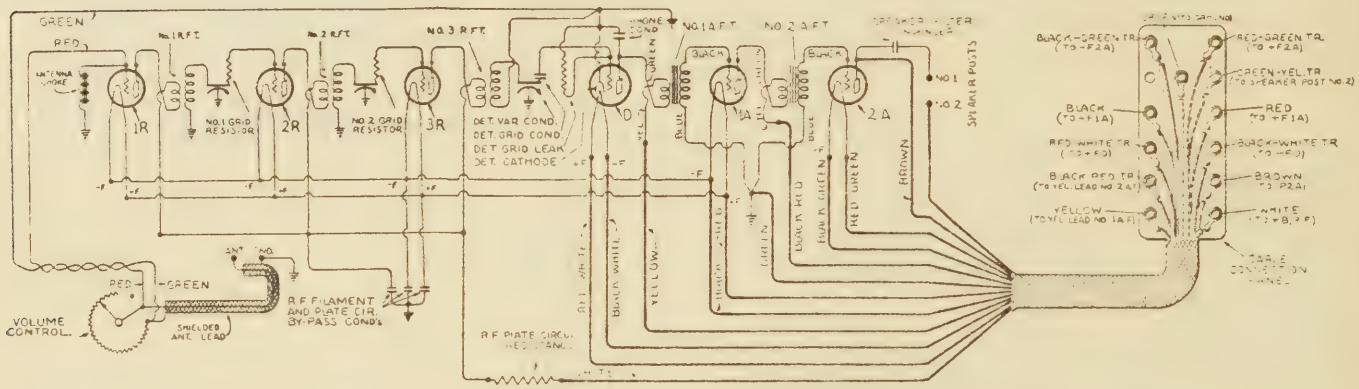


FIG. 57. WIRING DIAGRAM OF MODEL 37. (A 2nd A.F. filament shunt resistance is used before Serial No. 1,385,000, in which case speaker post No. 2 connects to the centre-tap of this resistance, and the green-yellow tracer lead is not used. The R.F. plate circuit resistance is used after Serial No. 1,385,000. Note that the red and the black cable leads feed the R.F. filaments as well as the 1st A.F. filament.)

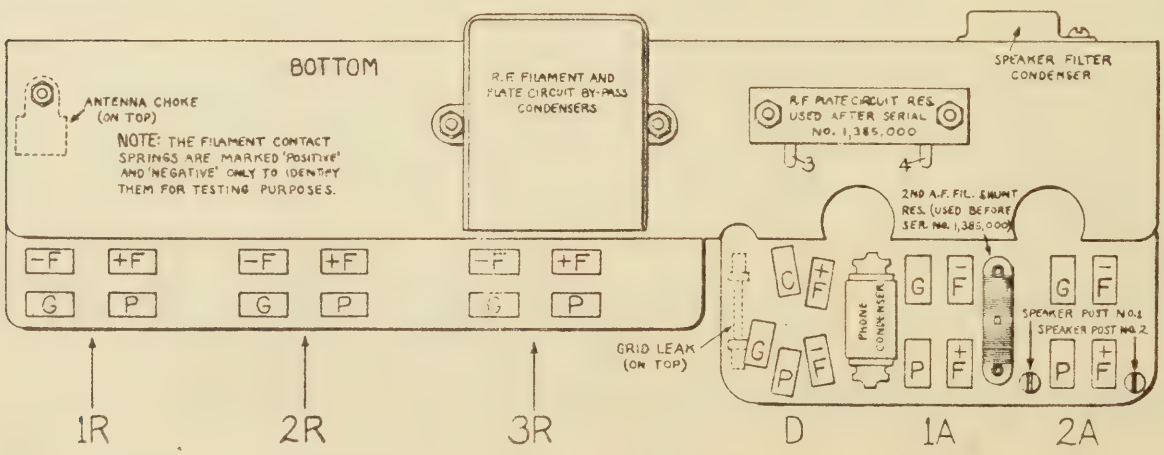


FIG. 58. TESTING CHART FOR MODEL 37.

Continuity Test Table—Model 37

Colors Refer to Cable Leads

For Following Tests Remove Cable Panel from Power Unit

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
Red-Green Tr. to +F2A Black-Green Tracer to —F2A Red-White Tr. to +FD Black-White Tracer to —FD Red to +F1A Black to —F1A Green-Yellow Tracer to Speaker Post No. 2. (After Serial No. 1,385,000.) Green to Ground Post. Brown to P2A. White to 4 (on R.F. Plate Resistance. (After Serial No. 1,385,000.)	*Full*	Open in cable or connection.	Examine soldered connections at cable connection panel and set.
GREEN to			
P1A	*None*	Grounded 1st A.F. plate circuit.	
PD	*None*	Grounded detector plate circuit.	Or shorted phone condenser.
P3R	*None*	Grounded R.F. plate circuit.	Or shorted R.F. by-pass condenser.
+F3R, —F3R	*None*	Grounded R.F. 1st A.F. filament circuit.	Or shorted R.F. by-pass condenser.
+FD, —FD	*None*	Grounded detector filament circuit.	
+F2A, —F2A	*None*	Grounded 2nd A.F. filament circuit.	
G2R, G3R	*Partial*	None—Open grid resistor or secondary No. 1, 2 R.F.T. Full—Shorted grid circuit.	Test across resistors and secondaries separately. (Resistors mounted on back of R.F. var. conds.)
G1R (Volume Control Full Right.)	*Full*	Open antenna choke.	
G1A	*Partial*	None—Open secondary No. 1 A.F.T.	Full—Shorted secondary.
G2A	*Partial*	None—Open secondary No. 2 A.F.T.	Full—Shorted secondary.
Stator of Detector Variable Condenser	*Full*	Open secondary last R.F.T.	
CD	*Full*	Open cathode lead.	
WHITE to			
3 (on R.F. Plate Res.) (After Serial No. 1,385,000.)	*Partial*	None—Open R.F. plate circuit resistance.	Full—Shorted R.F. plate circuit res.
P1R, P2R, P3R.	*Partial**	Open primary No. 1, 2, 3 R.F.T.	
YELLOW to PD	*Partial*	None—Open primary No. 1 A.F.T. (or open in cable connection).	Full—Shorted primary.
Black-Red, Tr. to P1A	*Partial*	None—Open primary No. 2 A.F.T. (or open in cable connection).	Full—Shorted primary.
OTHER TESTS			
GD to Stator of Last Condenser.	*None*	Shorted grid condenser.	Mounted on back of det. var. cond.
P2A to Speaker Post No. 1.	*None*	Shorted speaker filter condenser.	
G1R to Antenna Post.	*Full*	Open antenna connection.	
Speaker Post No. 2 to —F2A, +F2A (Before Serial No. 1,385,000.)	*Full*	Open connection or open 2nd A.F. Filament shunt resistance.	
To Test Volume Control, Unsolder Lead from Antenna Choke to G1R and Test Across Antenna and Ground Posts. Turning Control Knob.	*Smooth and Nearly Full*	No reading—open resistance winding. Erratic reading—damaged resistance winding or slider.	If found defective, repair or install new control. Resolder antenna choke lead.

* The reading from **WHITE** to the plate of each R.F. tube is "full" in Model 37 sets prior to Serial No. 1,385,000.

tuning dial. Remove two screws which hold antenna-and-ground post bracket on inside back of cabinet. This bracket is not used on some Model 37 sets. Pull sub-panel straight back horizontally to allow volume control knob and dial shaft to clear, then lift set up and out.

Replacing Variable Condensers

If one variable condenser is defective, replace entire group of three variable condensers.

No. 9100 for Model 37 sets previous to Serial No. 1,360,000.

No. 13170 for Model 37 sets after Serial No. 1,360,000.

Use pulleys and belts of original group.

Procedure: Loosen nine screws holding condensers to front of metal frame. Note how pulleys and belts are arranged and then remove them. Replace one condenser at a time.

Remove two nuts on back of first variable condenser, which clamp grid resistor (grid condenser on last variable condenser) and lug of secondary lead. Remove three screws holding condenser to chassis and lift out the condenser.

Put in the replacement condenser and its three screws, without tightening screws, attach grid resistor and lug of secondary lead to top and bottom bolts respectively on back of condenser. Repeat procedure with other two variable condensers. When the replacement condensers are installed, put on the pulleys and belts, adjust belt tension and synchronize condensers. (See Section XI.)

Replacing R. F. Transformers

If one R. F. transformer is defective, replace R. F. amplifier assembly.

No. 9660 for sets below Serial No. 1,265,000.

No. 13030 for sets between Serial Nos. 1,265,000 and 1,385,000.

No. 13160 for sets above Serial No. 1,385,000.

Procedure: The R. F. amplifier assembly consists of three R. F. transformers mounted on a three-socket moulded base. The filament contacts are wired and have two leads for connection to filament contacts of first A. F. socket. The plate circuits are wired and have one lead for connection to the +B, R. F. (white) cable lead (in Model 37 sets up to Serial No. 1,385,000) or to the left-hand contact (No. 3) on the R. F. plate circuit resistance in Model 37 sets after Serial No. 1,385,000. A lead from the grid-end of each R. F. transformer is soldered to a lug which is to be fastened to the bottom bolt on back of the variable condenser immediately in front of each R. F. transformer. The three return leads from secondaries of R. F. transformers are to be soldered to (ground) lugs which are held by bolts that clamp the R. F. amplifier base to the frame of set.

In replacing R. F. amplifier assembly, the chassis must be removed from the cabinet or front panel. Unsolder three leads from by-pass condenser, leads from grid contact of the first R. F. socket, leads from the grid resistor (unsolder at grid contacts of sockets) two filament circuit leads (at filament contacts of first A. F. socket), and the +B, R. F. lead. Remove secondary wire lug from bottom bolt on each variable condenser. Unsolder, at grid contact, the lead from grid condenser, which lead passes through a hole in the R. F. base. Unsolder three leads from secondaries of R. F. transformer where they are soldered to lugs under bolts holding R. F. base to metal frame. Remove five bolts holding R. F. base to metal chassis and remove the old R. F. amplifier assembly.

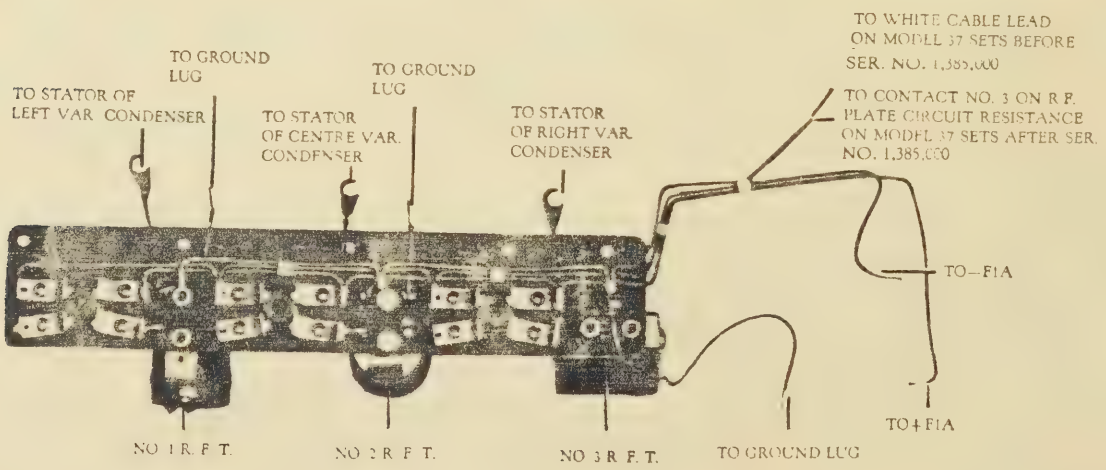


Fig. 59. View of R.F. Amplifier, Showing Where Each Wire Is To Be Connected.

Reassemble with replacement R. F. amplifier, reversing above procedure.

Replacing Volume Control

No. 9510 for Model 37 sets below Serial No. 1,265,000.

No. 13020 for Model 37 sets above Serial No. 1,265,000.

In replacing the volume control, the chassis must be removed from the cabinet.

The control is held to the front of the vertical side of the chassis by two screws and nuts, and it is mounted in such a way that the terminals of the control are at the right-hand side when looking at the chassis in its normal position. Remove the two screws, using a long-nose pliers to grip the nut on the bottom screw, which is somewhat hidden by the first audio transformer.

A red lead is soldered to the center (slider contact) of the three screws on the right-hand side of the control. The other end of this red lead is connected to the grid contact of the first R. F. socket.

A green lead is soldered to the lower one of the three screws. The other end of the green lead is soldered to a (ground) lug held under the right-hand bolt that clamps the R. F. amplifier assembly base to the metal frame. On earlier models the green lead is soldered to a lug under ground binding post.

Model 37 sets after Serial No. 1,265,000 employ a shielded antenna lead. The braided shield is clamped to the lower of the three screws on the right-hand side of the control, and the antenna lead (which runs inside the shield) is soldered to the center of the three screws. The other end of the shield is clamped to the ground terminal on the antenna-ground post bracket. The other end of the antenna lead is soldered to the antenna terminal on the bracket.

In Model 37 sets below Serial No. 1,265,000 the antenna post is mounted directly through the grid contact of the first R. F. socket. The ground post is held on a metal angle extending under the first R. F. socket.

Inspect the volume control carefully. If the resistance unit is damaged, replace with resistance unit No. 9788. Bend the slider so it will make firm contact with the resistance wire. Clean off the contact end of the slider and see that the top edge of resistance unit is free from dirt. If resistance unit is of old style with two sizes of wire, replace with new style (same part number) which has one size of resistance wire with increased spacing at one end. Also see that slider is of latest style.

When installing the new volume control, connect the leads in the manner specified above.

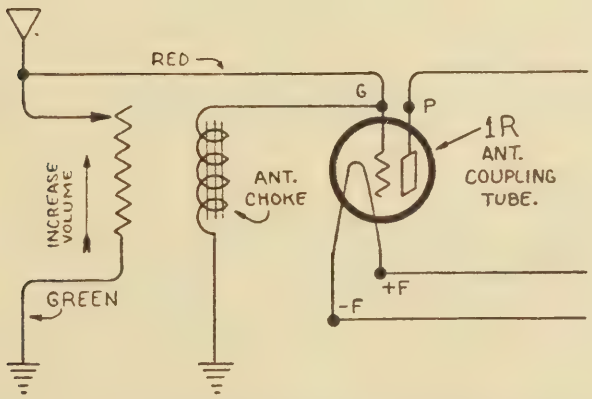


Fig. 60. Schematic Diagram of Volume Control in Models 37 and 38.

Model 38 Set

General Description

Model 38 is a seven-tube, single dial, A. C. receiver, with a power unit incorporated in the metal cabinet that houses the set.

The circuit has four stages of radio frequency amplification (with double coil type R. F. transformers), a tuned detector, and two stages of audio frequency amplification. The first R. F. tube is not tuned and acts as an antenna coupling tube. The second A. F. stage is of the power type with condenser-choke coupling to the speaker.

Since the volume provided by this powerful set is ordinarily more than required for local reception, a special switch (the "local-distance" toggle switch), is provided on the front of the cabinet, to open the plate circuit of the second R. F. amplifying tube, thereby reducing the volume materially.

The volume control consists of an adjustable resistance connected from antenna to ground.

Removing Set from Cabinet

First remove cover from power unit by taking out the two screws at its lower outside ends, and four bolts at bottom of front. Lift cover off vertically, exposing set cable connection panel. Remove nuts from terminals which pass through holes in cable connection panel and lift off latter, releasing cable from power unit.

Remove the dial and vernier knob. Then unscrew the eight machine screws which clamp the chassis to the cabinet. All of these machine screws are reached from inside the cabinet; three are at each end in a vertical row, the seventh is near the center of the vertical side of the metal frame of the set, and the eighth is near the center of the horizontal side of the frame. A magnetized screw driver will be found of great assistance in removing and replacing these screws. Remove two screws holding antenna-and-ground post bracket on inside back of cabinet.

(Continued on page 58.)

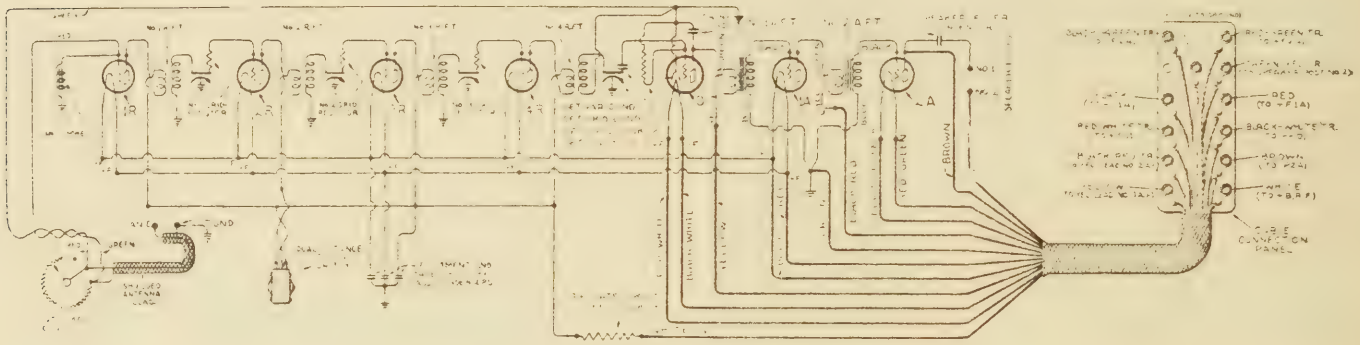


FIG. 61. WIRING DIAGRAM OF MODEL 38

A 2nd A. F. filament shunt resistance is used before Serial No. 1,752,000 and the green-yellow tracer cable lead is not used. Connections for this resistance are shown in dotted lines in the diagram on page 71. Note that the black and the red cable leads feed the R. F. filaments as well as the 1st A. F. filament. A schematic diagram of the volume control is shown in Fig. 60.

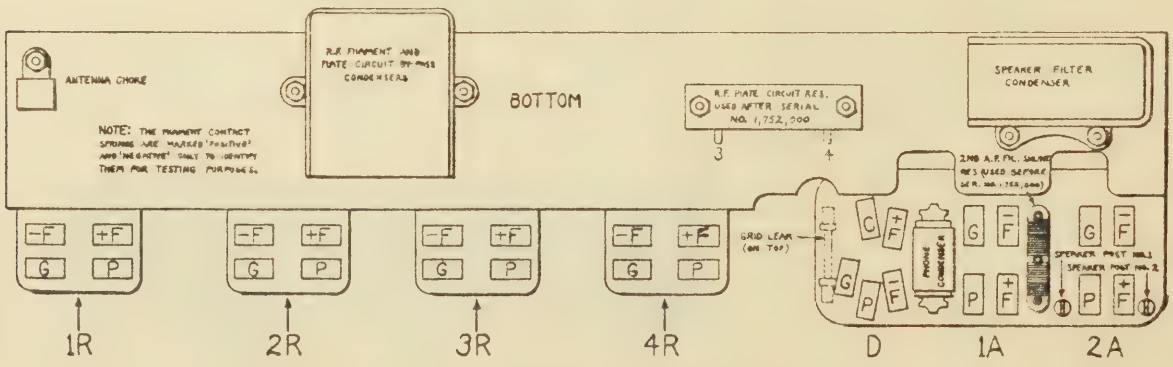


FIG. 62. TEST CHART FOR MODEL 38

Continuity Test Table—Model 38

Colors Refer to Cable Leads

For Following Tests Remove Cable Panel from Power Unit

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
Red-Green Tr. to +F2A Black-Green Tracer to —F2A Red-White Tr. to +FD Black-White Tracer to —FD Red to +F1A Black to —F1A Green-Yellow Tracer to Speaker Post No. 2. Green to Ground Post. Brown to P2A White to 4 (on R.F. Plate Resistance.) (After Serial No. 1,752,000.)	*Full*	Open in cable or connection.	Examine soldered connections at cable connection panel and set.
GREEN to			
P1A	*None*	Grounded 1st A.F. plate circuit.	
PD	*None*	Grounded detector plate circuit.	Or shorted phone condenser.
P3R	*None*	Grounded R.F. plate circuit.	Or shorted by-pass condenser.
+F3R, —F3R	*None*	Grounded R.F.-1st A.F. filament circuit.	Or shorted by-pass condenser.
+FD, —FD	*None*	Grounded detector filament circuit.	
+F2A, —F2A	*None*	Grounded 2nd A.F. filament circuit.	
G2R, G3R, G4R	*Partial*	None—Open grid resistance or secondary No. 1, 2, 3 R.F.T. Full—Shorted grid circuit.	Test across grid resistors separately. (Mounted on back of R.F. variable condensers.)
G1A	*Partial*	None—Open secondary No. 1 A.F.T.	Full—Shorted secondary.
G2A	*Partial*	None—Open secondary No. 2 A.F.T.	Full—Shorted secondary.
G1R (Volume Control Full Right.)	*Full*	None—Open antenna choke.	
Stator of Detector Variable Condenser.	*Full*	Open secondary last R.F.T.	
CD	*Full*	Open cathode lead.	
WHITE to			
3 (After Serial No. 1,752,000.)	*Partial*	None—Open R.F. plate circuit resistance.	Full—Shorted R.F. plate circuit res.
P1R, P2R, P3R, P4R ("Local-Distance" Switch "on.")	*Partial**	None—Open primary No. 1, 2, 3, 4 R.F.T.	No reading to P2R with switch "off."
YELLOW to			
PD	*Partial*	None—Open primary No. 1 A.F.T.	Full—Shorted primary No. 1 A.F.T.
Black-Red Tr. to P1A	*Partial*	None—Open primary No. 2 A.F.T.	Full—Shorted primary No. 2 A.F.T.
OTHER TESTS			
GD to Stator of Last Variable Condenser.	*None*	Shorted grid condenser.	Mounted on back of det. var. cond.
P2A to Speaker Post No. 1.	*None*	Shorted speaker filter condenser.	
G1R to Antenna Post.	*Full*	Open antenna connection.	
Speaker Post No. 2 to —F2A, +F2A. (Before Serial No. 1,752,000.)	*Full*	Open connection or open 2nd A.F. Filament shunt resistance.	
To Test Volume Control, Unsolder Connection from Antenna Choke to G1R and Test from Antenna to Ground Post, Turning Knob.	*Smooth and Nearly Full*	No reading—open in resistance winding. Erratic reading—damaged resistance wire or slider.	If found defective, repair or install new control. Resolder antenna choke lead.

*Note.—The reading from WHITE to each R. F. plate is "full" in Model 38 sets, prior to Serial No. 1,752,000

When the screws have been removed pull the set straight back horizontally so that the condenser shaft and volume control clear the cabinet and then lift the set up carefully and rest it on top of the cabinet while removing the "local-distance" toggle switch from the front of the cabinet. Loosen hexagon nut on toggle switch with an open-end wrench and unscrew knurled lock nut from front of toggle switch with fingers. Never use a wrench or pliers on the knurled nut.

Replacing Variable Condensers

If one variable condenser is defective, replace entire group of four variable condensers.

No. 13210 for Model 38 sets below Serial No. 1,752,000.

No. 13200 for Model 38 sets above Serial No. 1,752,000.

Use pulleys and belts of original group.

Procedure: Loosen twelve screws holding variable condensers to metal frame. Note how pulleys and belts are arranged and then remove them. Replace one condenser at a time.

Remove the double R. F. transformers which are mounted on backs of variable condensers (do not unsolder transformer leads), at the same time removing the grid resistors, the grid condenser and the lugs of secondary leads, which are held to the condensers by the same nuts that hold the R. F. transformer brackets.

Remove the three screws holding first condenser, lift out the condenser and put in replacement without tightening screws. Mount the first R. F. transformer, the first grid resistor and the secondary lead lug, on the two bolts on back of the condenser. Make certain that the axes or long sides of the transformer coils are vertical. This may be checked by seeing that the sides of the coils are parallel to the vertical metal strip on the back of the condenser.

Repeat procedure with each condenser and, when all four are in place, put on the pulleys and belts, adjust belt tension and synchronize condensers. (See Section XI.)

Replacing R. F. Transformers

If one double R. F. transformer is defective, replace entire group of four double R. F. transformers. Part No. 13220.

One lead on each transformer has a distinctive color, as follows:

No. 1 has a white lead.

No. 2 has a green lead.

No. 3 has a yellow lead.

No. 4 has a blue lead.

Procedure: In replacing double R. F. transformers, substitute one transformer at a time, mounting and connecting the replacement exactly like the original. Do not mix up the old coils with the replacements.

Remove two nuts on back of first variable condenser which hold R. F. transformer brackets, unsolder transformer connections and remove old transformer. Put replacement transformer in position, seeing that the grid resistor and lug of secondary lead are replaced properly, and tighten the two nuts. The transformer angle brackets must be arranged so that the axes or long sides of the coil are vertical. This may be checked by seeing that the long sides of the coils are parallel to the vertical metal strip on the back of the variable condenser. Solder leads exactly like the original.

Repeat procedure with each R. F. transformer.

Replacing Volume Control (No. 13,018)

In replacing the volume control, the chassis must be removed from the cabinet.

The control is held to the chassis by two screws and nuts, and it is mounted in such a way that the terminals of the control are at the right-hand side when looking at the chassis in its normal position. Remove the two screws, holding the bottom nut with a long-nose pliers as this nut is somewhat closed in by the first A. F. transformer.

A red lead is soldered to the center (slider contact) of the three screws on the right hand side of the control. The other end of this red lead is connected to the grid contact of the first R. F. socket.

A green lead is soldered to the lower one of the three screws. The other end of this green lead is soldered to a (ground) lug held under the right hand one of the two screws that clamp the fourth R. F. socket to the metal frame.

The lead from the antenna post is run through a braided metal shield and connects to the center of the three screws on the volume control. One end of the braided shield is clamped to the lower one of the three screws on the volume control and the other end

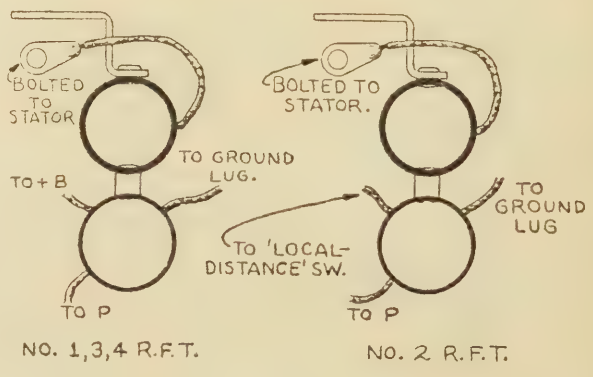


FIG. 63. SKETCH SHOWING CONNECTIONS FROM R. F. TRANSFORMERS

is clamped to the ground post. The antenna and ground posts are mounted on a small bracket that is screwed inside the back of the cabinet.

Inspect the volume control carefully. If the resistance unit is damaged, replace with resistance unit No. 9788. Bend the slider so it will make firm contact with the resistance wire. Clean off the contact end of the slider and see that the top edge of the resistance unit is free from dirt. If resistance unit is of old style with two sizes of wire, replace with new style (same part number) having one size of wire with increased spacing at one end. Also see that slider is of latest style.

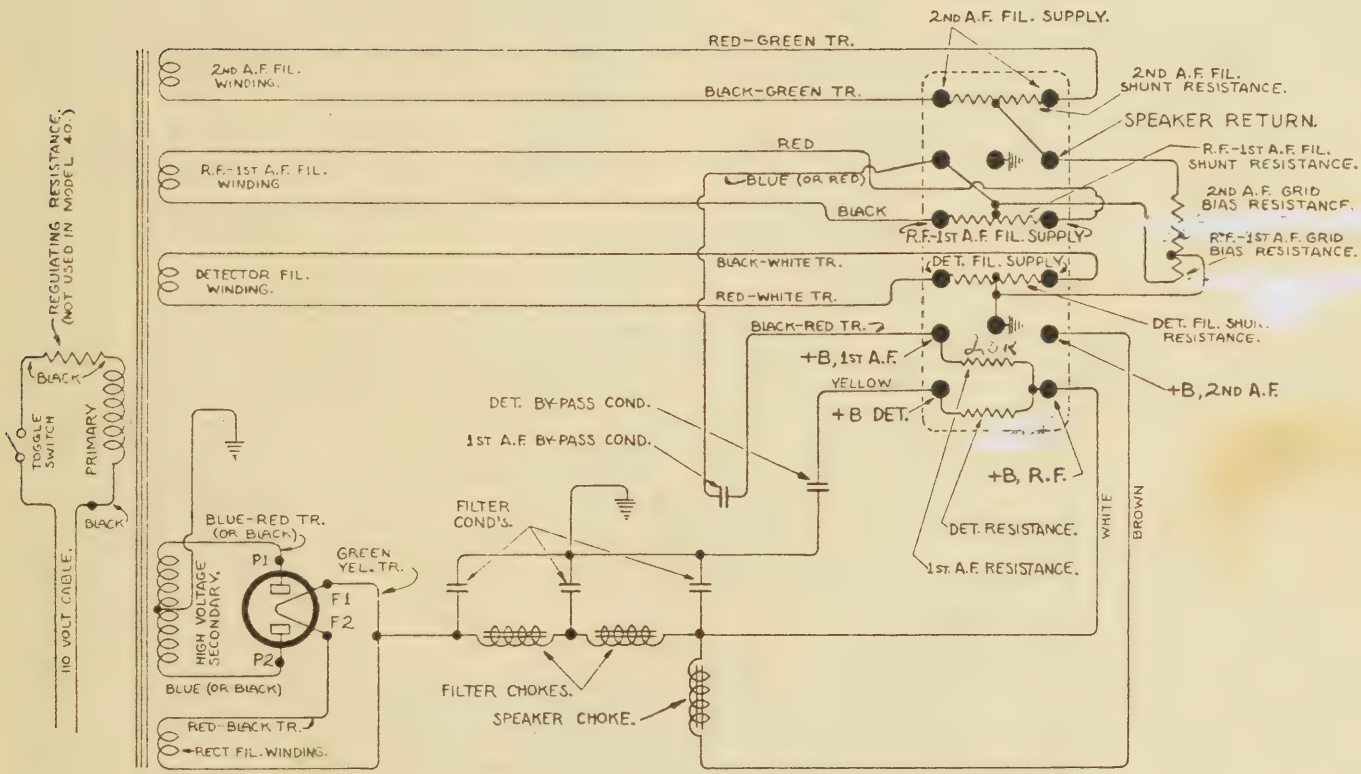


FIG. 63-A. SCHEMATIC DIAGRAM OF POWER UNIT IN MODELS 40, 42, 44, AND 52. SEE PAGE 69 FOR DESCRIPTION OF THIS UNIT. SOME EARLY UNITS OF THIS TYPE HAVE COLOR SCHEME SIMILAR TO UNIT IN MODEL 38 SET. NOTE THAT COLORS AS NOW STANDARDIZED CORRESPOND WITH THE COLORS OF SET-CABLE LEADS.

Power Units in Models 37 and 38 Sets

General Description

Power units in Models 37 and 38 receiving sets are mounted inside the metal cabinet of the set. The units are encased in a metal cover which has an opening in the left hand end of the top for insertion of the rectifier tube.

The power unit is designed for operation on 110 volt, alternating current, and furnishes complete filament, plate and grid voltages to the set.

The unit has two metal containers, one for the power transformer and one for the condensers and chokes.

Information about Atwater Kent power units is given in the Section I of this Manual.

Removing Unit from Cabinet

Remove the cover and cable connection panel from the power unit and remove the set itself from the cabinet. (See instructions for removing 37 set chassis from cabinet). Then remove the A. C. toggle switch by loosening the hexagonal nut with an open-end wrench, unscrewing the front knurled lock-nut with the fingers. Never use a wrench or pliers on the knurled nut, as it will scratch up the nut and probably mar the finish of the cabinet. Note that the toggle switch leads come from the right hand side of the cabinet; arrange the switch in the same way when replacing so it will be "on" when the button is pushed to the right.

The power unit is held to the cabinet by three screws at each end, two of the six screws being the two rear

(Continued on page 62.)

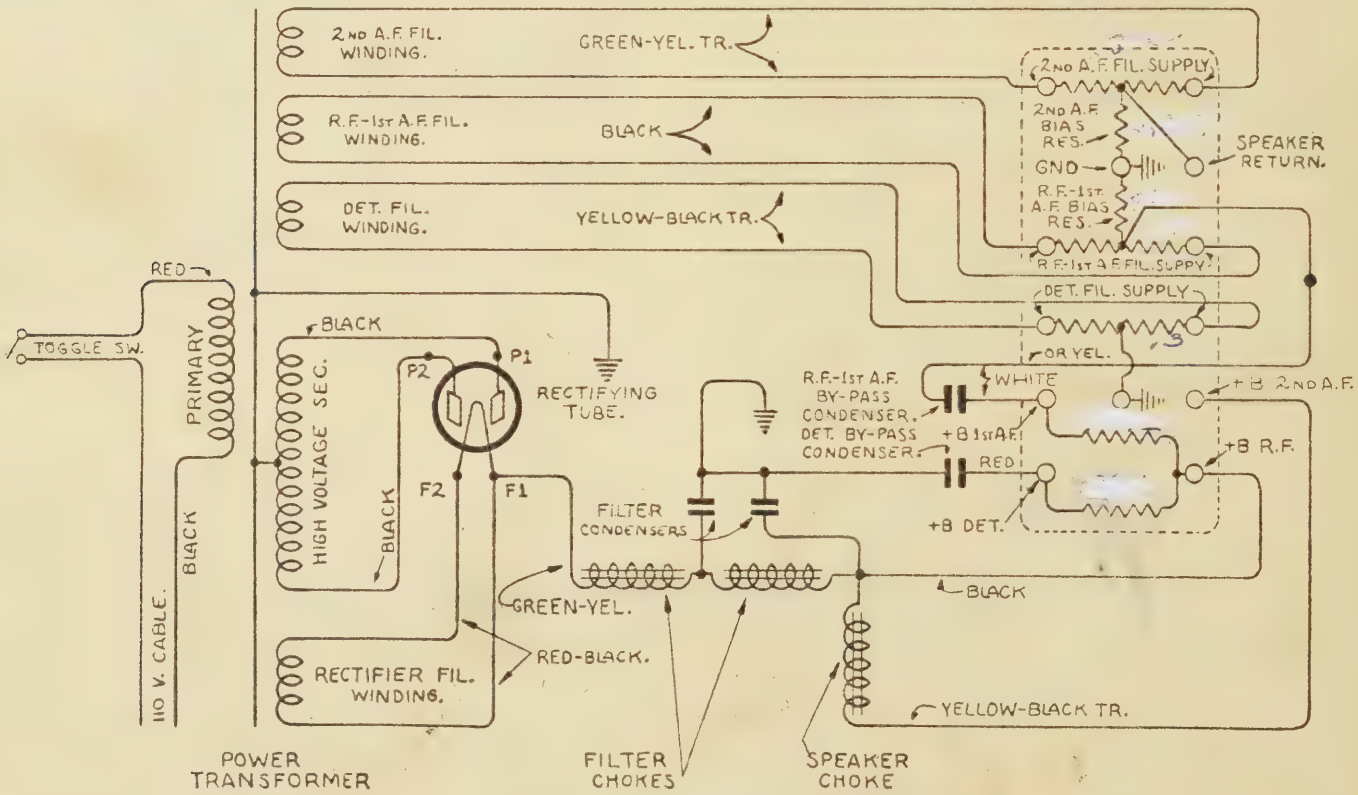


FIG. 64. DIAGRAM OF POWER UNIT IN MODELS 37 AND 38

The diagram of the power unit in Models 40, 42, 44 and 52 is similar to that shown above with the following exceptions: A regulating resistance is connected in series with the primary circuit in Models 42, 44 and 52. A filter condenser is connected between F1 and ground. The junction point of the bias resistance is connected to the lower instead of the upper ground eyelet. The color scheme is different and is shown in Fig. 77.

Continuity Test Table and Chart—Power Unit for Models 37 and 38

For Following Tests Remove Cable Panel from Power Unit

TEST	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
Across 2nd A.F. Filament Supply.	*Full*	None—Open 2nd A.F. fil. winding and open 2nd A.F. filament shunt resistance.	Nearly full—open filament winding. (Unsolder one fil. winding connection and test winding and fil. shunt resistance separately.)
Across R.F.-1st A.F. Filament Supply.	*Full*	None—Open R.F.-1st A.F. fil. winding and open R.F.-1st A.F. fil. shunt res.	Nearly full—open filament winding. (Unsolder one fil. winding connection and test winding and fil. shunt resistance separately.)
Across Detector Filament Supply.	*Full*	None—Open det. fil. winding and open detector filament shunt resistance.	Nearly full—open filament winding. (Unsolder one fil. winding connection and test winding and fil. shunt resistance separately.)
FROM +B R.F. to			
+B 2nd A.F.	*Partial*	None—Open speaker (output) choke.	Full—Shorted speaker choke.
+B 1st A.F.	*Small*	None—Open 1st A.F. plate circuit res.	
+B Detector.	*Very Small*	None—Open detector plate circuit res.	
Ground.	*None*	Shorted filter condenser.	
F1 (on Rectifier Tube Socket.)	*Partial*	None—Open plate supply filter choke.	
FROM GROUND to			
+B Detector.	*None*	Shorted by-pass condenser.	
One Side of 2nd A.F. Filament Supply.	*Partial*	None—Open 2nd A.F. grid bias resistance.	Full—Shorted bias resistance.
One Side of R.F.-1st A.F. Filament Supply.	*Partial*	None—Open R.F.-1st A.F. grid bias resis.	Full—Shorted bias resistance.
One Side of Detector Filament Supply.	*Full*	Open connection to center-tap of detector filament shunt resistance.	Examine connections under panel assembly.
+B 1st A.F.	*None*	Shorted by-pass condenser.	
P1, P2 (on Rectifier Tube Socket.)	*Nearly Full*	None—Open high voltage sec. winding.	
Each Terminal of A.C. Plug.	*None*	Grounded primary of power transformer.	Inspect A.C. cable and switch leads for accidental grounds.
OTHER TESTS			
Across Terminals of A. C. Plug. (Toggle Switch "On.")	*Full*	Open primary of transformer or open cable or switch leads.	
F1 to F2 (on Rectifier Tube Socket.)	*Full*	Open rectifier filament winding or connections.	
One Side of 2nd A.F. Filament Supply to Speaker Return Terminal.	*Full*	Open connection to center-tap of 2nd A.F. filament shunt resistance.	

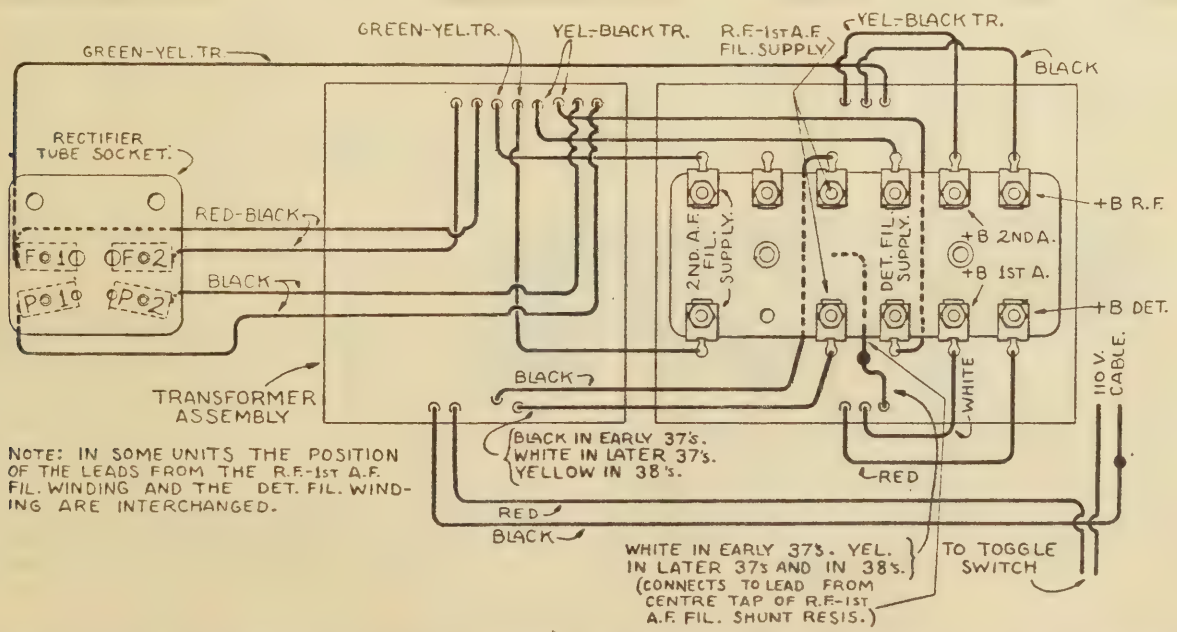


FIG. 65. SHOWING CONNECTIONS FROM TRANSFORMER AND CONDENSER-CHOKE ASSEMBLIES TO PANEL ASSEMBLY

This view shows the approximate position of leads from the metal containers. In replacement condenser-choke assemblies for Model 38 the lead to +B first A. F. terminal is sometimes black-red tracer instead of white.

felt-headed feet of the cabinet. The transformer and condenser-choke sections are held to the base of the power unit by three long bolts and a single heavy metal strap. The panel assembly is fastened to the metal strap by two screws and nuts—one the ground terminal and the other at the center toward the opposite end of the panel assembly.

Note that a bare braided wire comes from each metal container and that these wires are soldered to lugs which are fastened to two of the long bolts.

Testing

Apply the continuity tests given in the table. If the tests indicate that one section of the unit is defective, replace that section, connecting it exactly as the original.

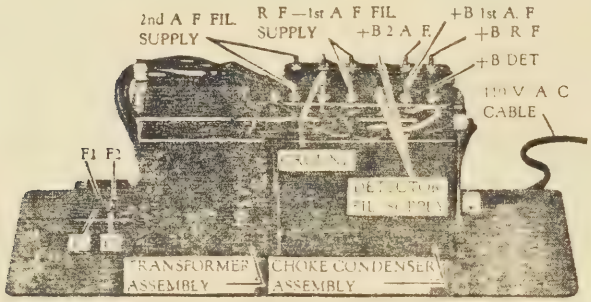


FIG. 66. POWER UNIT IN MODELS 37 AND 38. COVER REMOVED

The unit illustrated is for a Console 37 and the two terminals on either side of the ground terminal are used for toggle switch connection in the 110 volt line.

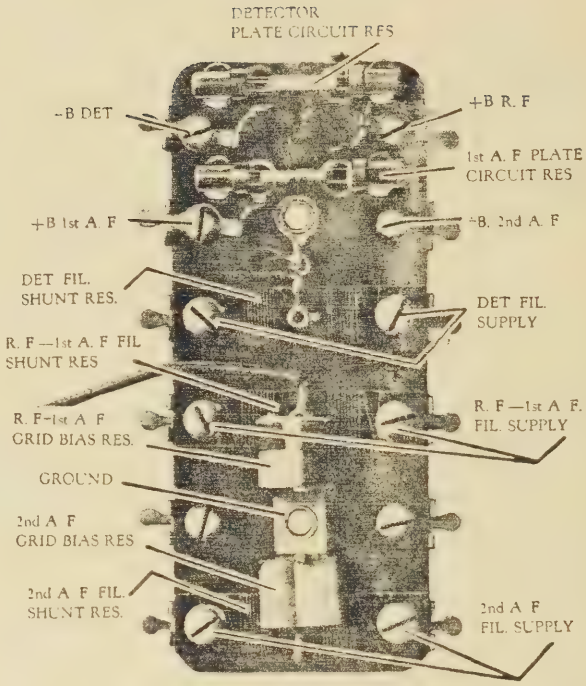


FIG. 67. REAR VIEW OF PANEL ASSEMBLY ON MODELS 37, 38 AND LATER TYPE "Y" POWER UNITS

The terminal on the right hand side of the ground eyelet is used as "speaker-return" terminal on later Models 37 and 38 sets. In Model 37 Console sets, and in later type "Y" power units, the terminals on either side of the ground eyelet are used for toggle switch connection in the 110 volt line.

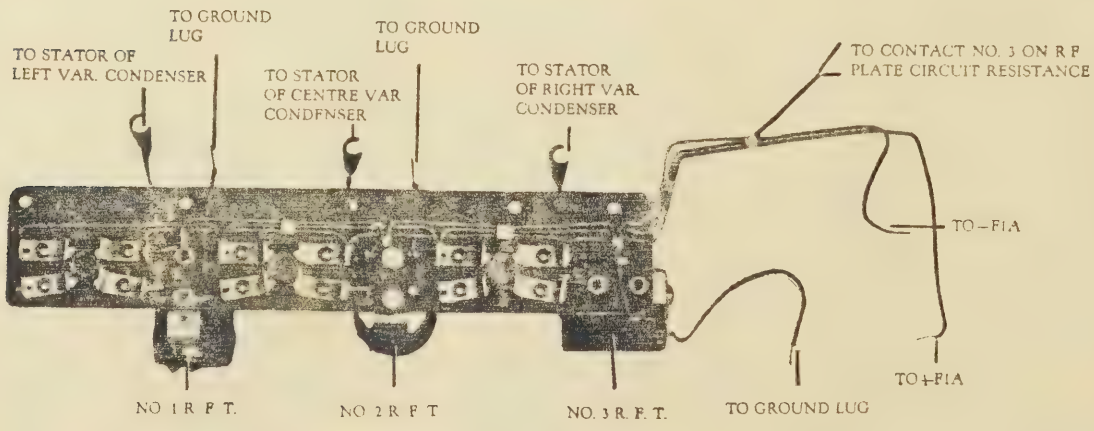


FIG. 68. VIEW OF R. F. AMPLIFIER ASSEMBLY IN MODELS 40, 42 AND 52, SHOWING WHERE EACH LEAD IS TO BE CONNECTED

Model 40, 42, and 52 Sets

General Description

The Models 40, 42 and 52 are six-tube single-dial A. C. receivers with complete power unit incorporated in the metal cabinet that houses the set. The power unit operates from 110 volt, alternating current, and supplies complete filament, plate and grid voltages to the set. The power unit is sealed in a single metal container.

Models 42 and 52 are equipped with an automatic voltage regulator in series with one side of the A. C. line. This device is so designed that owing to the heating effect, a voltage above normal (110) will increase its resistance value, and a voltage below normal will decrease its resistance, so that the voltage across the primary of the transformer is maintained at a constant value.

The circuit of each set has three stages of radio frequency amplification, the first stage acting as a coupling tube in order to eliminate the detuning effect of different antenna sizes (which would otherwise disturb the synchronism of the three tuned circuits). There is a tuned detector and two stages of audio frequency amplification.

The volume control consists of a resistance connected across a section of the antenna coupling transformer. A slider on this resistance connects to ground, and the antenna is connected to one side of the resistance. By adjusting the slider, more or less of the antenna current may be shunted to ground, thus decreasing or increasing the volume.

Model 52 has a metal cabinet about thirty inches high, with a cone speaker mounted in the lower section of the cabinet.

Removing Set from Cabinet

Lift off the cover of the power unit and remove the nuts from posts which pass through the holes in cable connection panel, releasing the cable from power unit.

Remove dial and vernier knob. Remove two screws which hold antenna-and-ground post bracket on inside back of cabinet. (Model 52 does not have this bracket.) Remove the six screws, three in a vertical row at each end, which clamp the chassis to the inside front of cabinet. Pull chassis straight back horizontally to allow condenser shaft and volume control to clear front of cabinet, then lift set up and out.

In Model 52 pull up the antenna and ground leads and remove speaker leads from posts on set.

Replacing Variable Condensers

If one variable condenser is defective, replace entire group of three condensers. Use pulleys and belts of original group.

Procedure: Remove set from cabinet. Loosen nine screws holding condensers to front of metal frame. Note how pulleys and belts are arranged and then remove them. Replace one condenser at a time. Do not mix old condensers with the replacements.

Remove two nuts on back of first variable condenser, which clamp grid resistor (grid condenser on last variable condenser) and lug of secondary lead. Remove three screws holding condenser to chassis and lift out the condenser.

Put in the replacement condenser and its three screws, without tightening screws, attach grid resistor and lug of secondary lead to top and bottom bolts respectively on back of condenser. Repeat procedure with other two variable condensers. When the replacement condensers are installed, put on the pulleys and belts, adjust belt tension and synchronize condensers (see Section XI).

Replacing R. F. Transformers

If one R. F. transformer is defective, replace R. F. amplifier assembly. (See Fig. 68.) The R. F. amplifier assembly consists of three R. F. transformers mounted on a three-socket moulded base. The filament contacts are wired and have two leads for connection to filament contacts of first A. F. socket. The plate circuits are wired and have one lead for connection to the left hand contact (No. 3) on the R. F. plate circuit resistance. A lead from the grid end of each R. F. transformer is soldered to a lug which is to be fastened to the bottom bolt on back of the variable condenser immediately in front of each R. F. transformer. The three return-leads from secondaries of each R. F. transformer are to be soldered to ground lugs which are held by bolts that clamp the R. F. amplifier base to the frame of set.

In replacing R. F. amplifier assembly, the chassis must be removed from the cabinet. Unsolder three leads from by-pass condenser, lead from grid contact of the first R. F., socket, leads from the grid resistors (unsolder at grid contacts of sockets), two filament circuit leads (at filament contacts of first A. F. socket), and the +B, R. F. lead. Remove secondary wire lug from bottom bolt on each variable condenser. Unsolder, at grid contact, the lead from grid condenser, which passes through a hole in the R. F. base. Unsolder three leads from secondaries of R. F. transformers where they are soldered to lugs under bolts holding R. F. base to metal frame. Remove five bolts holding R. F. base to metal chassis and remove the old R. F. amplifier assembly.

Reassemble with replacement R. F. amplifier, reversing above procedure.

Replacing Volume Control

Remove chassis from cabinet.

The volume control is held to the metal frame by two screws and nuts and is mounted in such a way that the three terminals are on the right hand side when looking at the chassis in its normal position. Remove the two screws, using a long-nose pliers to grip the bottom nut, which is close to the second A. F. transformer.

(Continued on next page.)

A yellow lead connects the top one of the three terminals to the inside end of the antenna coupling transformer.

A red lead connects the bottom one of the three terminals to the tap on the antenna coupling transformer.

A green lead runs from the center terminal (slider contact) to a (ground) lug held under the right hand bolt that clamps the base of the R. F. amplifier assembly to the metal frame.

The lead from the antenna post runs through a braided metal shield and is soldered to the lower one of the three terminals on the volume control. The metal braid is clamped to the center one of the three terminals. The other end of the metal braid is clamped to the ground post.

Model 52 does not have the shielded antenna lead. In this set two twenty-foot leads are connected to the volume control, black for antenna, and black-green tracer for ground.

(The outside end of the antenna coupling transformer is connected to the grid contact of the first R. F. socket).

Inspect the volume control carefully. If the resistance unit is damaged, replace with latest style of resistance unit. Bend the slider so it makes firm contact with resistance wire. Clean the contact end of the slider and the top edge of the resistance unit. See that slider is of latest type.

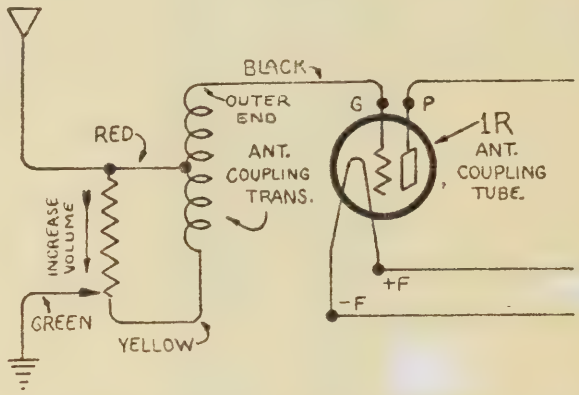


Fig. 69. Schematic Diagram of Volume Control, Models 40, 42, 44 and 52

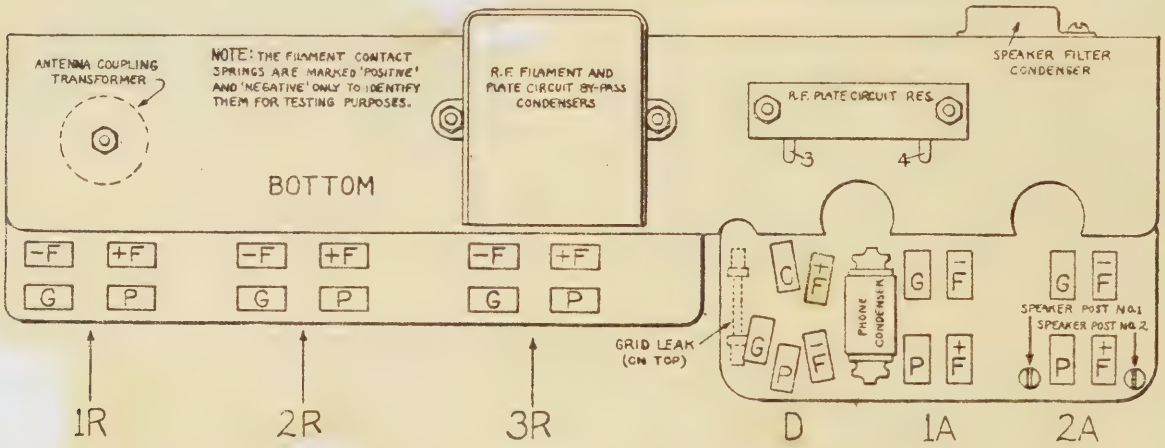


Fig. 70. Test Chart for Models 40, 42, 52

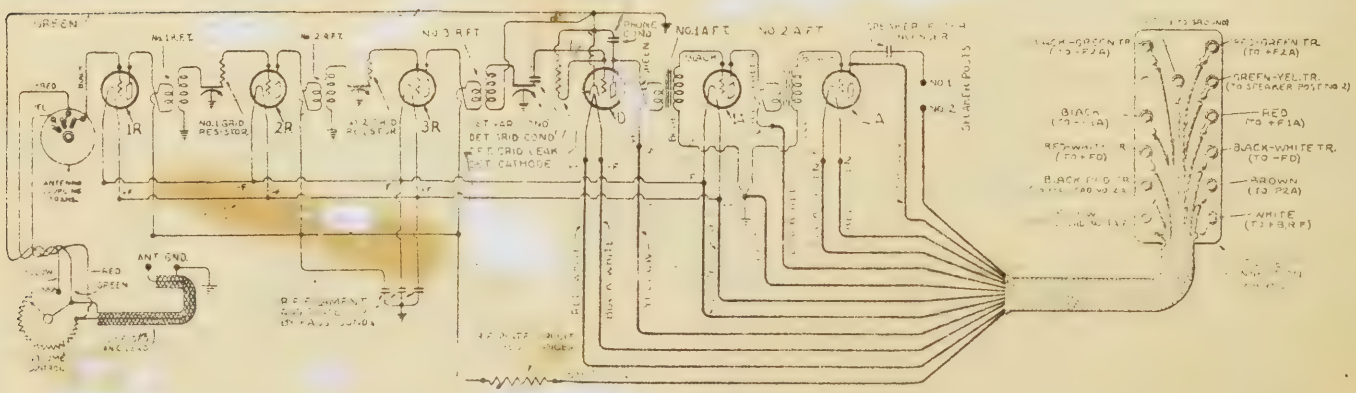


Fig. 71. Wiring Diagram of Models 40, 42 and 52

Model 52 does not have the shielded antenna lead, but is provided with two twenty-foot leads which are connected to the volume control, black for antenna and black-green tracer for ground.

Continuity Test Table—Models 40, 42 and 52

Colors Refer to Cable Leads

For Following Tests Remove Cable Panel from Power Unit

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
Red-Green Tr. to +F2A Black-Green Tracer to —F2A Red-White Tr. to +FD Black-White Tracer to —FD Red to +F1A Black to —F1A Green-Yellow Tracer to Speaker Post No. 2. Green to Ground Post. Brown to P2A. White to 4 (on R.F. Plate Resistance).	*Full*	Open in cable or connection.	Examine soldered connections at cable connection panel and set.
GREEN to			
P1A	*None*	Grounded 1st A.F. plate circuit.	
PD	*None*	Grounded detector plate circuit.	Or shorted phone condenser.
P3R	*None*	Grounded R.F. plate circuit.	Or shorted R.F. by-pass condenser.
+F3R, —F3R	*None*	Grounded R.F.-1st A.F. filament circuit.	Or shorted R.F. by-pass condenser.
+FD, —FD	*None*	Grounded detector filament circuit.	
+F2A, —F2A	*None*	Grounded 2nd A.F. filament circuit.	
G2R, G3R	*Partial*	None—Open grid resistor or secondary No. 1, 2 R.F.T. Full—Shorted grid circuit.	Test across resistors and secondaries separately. (Resistors mounted on back of R.F. var. conds.)
G1R	*Full*	Open antenna coupling transformer.	Volume control full right.
G1A	*Partial*	None—Open secondary No. 1 A.F.T.	Full—Shorted secondary.
G2A	*Partial*	None—Open secondary No. 2 A.F.T.	Full—Shorted secondary.
Stator of Detector Variable Condenser	*Full*	Open secondary last R.F.T.	
CD	*Full*	Open cathode lead.	
WHITE to			
3 (on R.F. Plate Res.)	*Partial*	None—Open R.F. plate circuit resistance.	Full—Shorted R.F. plate circuit res.
P1R, P2R, P3R.	*Partial*	Open primary No. 1, 2, 3 R.F.T.	
YELLOW to			
PD	*Partial*	None—Open primary No. 1 A.F.T. (or open in cable connection).	Full—Shorted primary.
Black-Red Tracer to P1A	*Partial*	None—Open primary No. 2 A.F.T. (or open in cable connection).	Full—Shorted primary.
OTHER TESTS			
GD to Stator of Last Condenser.	*None*	Shorted grid condenser.	Mounted on back of det. var. cond.
P2A to Speaker Post No. 1.	*None*	Shorted speaker filter condenser.	
G1R to Ant. Terminal.	*Full*	Open antenna connection.	
To Test Volume Control, Unsolder Red Lead from Antenna Coupling Transformer and Test Across Antenna and Ground Terminals, Turning Control Knob.	*Smooth and Nearly Full*	No reading—open resistance winding. Erratic reading—damaged resistance winding or slider.	If found defective, repair or install new control. Resolder red lead.

Model 44 Set

General Description

Model 44 set is similar to the Model 38 in design, but with the same improvements as contained on the Model 42, that is, newly designed cabinet, antenna coupling transformer and automatic voltage regulator. The power unit of Model 44, as in Models 40, 42 and 52, is sealed in a single metal container. Model 44 also contains the "local-distance" switch which is featured in the Model 38, but in Model 44, this switch cuts out a part of the primary of the second R. F. T.

The circuit has four stages of radio frequency amplification (with double-coil type R. F. transformers), a tuned detector, and two stages of audio frequency amplification. The first R. F. tube acts as an antenna coupling tube. The second A. F. stage is of the power type with condenser-choke coupling to the speaker.

The volume control consists of a resistance connected across a portion of the antenna coupling transformer. The slider on this resistance connects to ground, and the antenna connects to one end of the resistance. By turning the slider (ground) toward the antenna end of the resistance, the volume is decreased.

Removing Set from Cabinet

Lift off the cover of power unit and remove nuts from posts which pass through holes in the cable connection panel, releasing the cable. Remove dial and vernier knob. Remove two screws which hold antenna-and-ground post bracket on back of cabinet.

As in the Model 38, the chassis of the Model 44 is held to the cabinet by eight machine screws, all reached from inside the cabinet. Three screws are in a vertical

(Continued on page 68.)

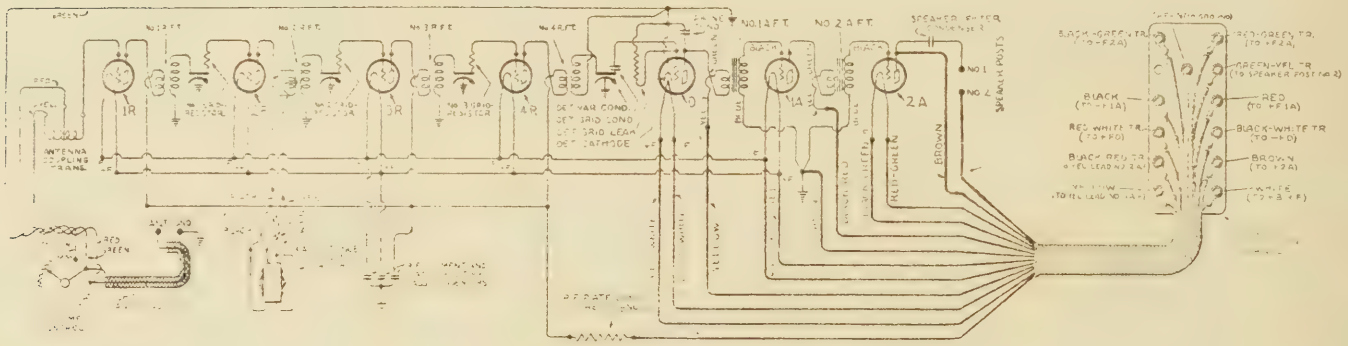


FIG. 72. WIRING DIAGRAM OF MODEL 44

A schematic diagram of the volume control is shown in Fig. 69. The ground connection to the R. F. by-pass condensers, in this and other models, is made through the metal container in which the condensers are sealed. A pictorial representation of the antenna coupling transformer is shown in Fig. 71.

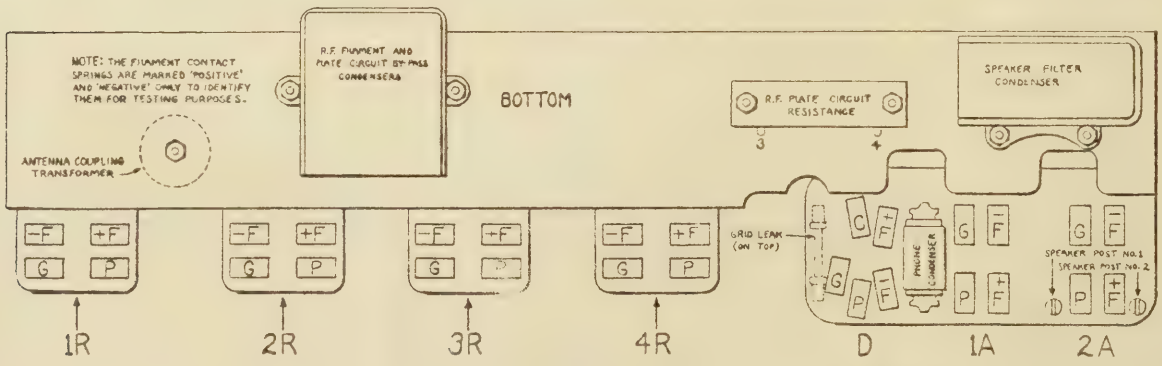


FIG. 73. TEST CHART FOR MODEL 44

Continuity Test Table—Model 44

Colors Refer to Cable Leads

For Following Tests Remove Cable Panel from Power Unit

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
Red-Green Tr. to +F2A Black-Green Tracer to —F2A Red-White Tr. to +FD Black-White Tracer to —FD Red to +F1A Black to —F1A Green-Yellow Tracer to Speaker Post No. 2. Green to Ground Post. Brown to P2A White to 4 (on R.F. Plate Resistance.)	*Full*	Open in cable or connection.	Examine soldered connections at cable connection panel and set.
GREEN to			
P1A	*None*	Grounded 1st A.F. plate circuit.	
PD	*None*	Grounded detector plate circuit.	Or shorted phone condenser.
P3R	*None*	Grounded R.F. plate circuit.	Or shorted by-pass condenser.
+F3R, —F3R	*None*	Grounded R.F.-1st A.F. filament circuit.	Or shorted by-pass condenser.
+FD, —FD	*None*	Grounded detector filament circuit.	
+F2A, —F2A	*None*	Grounded 2nd A.F. filament circuit.	
G2R, G3R, G4R	*Partial*	None—Open grid resistance or secondary No. 1, 2, 3 R.F.T. Full—Shorted grid circuit.	Test across grid resistors separately. (Mounted on back of R.F. variable condensers.)
G1A	*Partial*	None—Open secondary No. 1 A.F.T.	Full—Shorted secondary.
G2A	*Partial*	None—Open secondary No. 2 A.F.T.	Full—Shorted secondary.
G1R	*Full*	None—Open antenna coupling transformer.	Volume control full right.
Stator of Detector Variable Condenser.	*Full*	Open secondary last R.F.T.	
CD	*Full*	Open cathode lead.	
WHITE to			
3 (on R.F. Plate Res.)	*Partial*	None—Open R.F. plate circuit resistance.	Full—Shorted R.F. plate circuit res.
P1R, P2R, P3R, P4R ("Local-Distance" Switch Up.)	*Partial*	None—Open primary No. 1, 2, 3, 4 R.F.T.	Partial reading to P2R with "Local-distance" switch down.
YELLOW to			
PD	*Partial*	None—Open primary No. 1 A.F.T.	Full—Shorted primary No. 1 A.F.T.
Black-Red Tr. to P1A	*Partial*	None—Open primary No. 2 A.F.T.	Full—Shorted primary No. 2 A.F.T.
OTHER TESTS			
GD to Stator of Last Variable Condenser.	*None*	Shorted grid condenser.	Mounted on back of det. var. cond.
P2A to Speaker Post No. 1.	*None*	Shorted speaker filter condenser.	
G1R to Antenna Post.	*Full*	Open antenna connection.	
To Test Volume Control, Unsolder Red Lead from Antenna Coupling Transformer and Test Across Antenna and Ground Terminals, Turning Control Knob.	*Smooth and Nearly Full*	No reading—open in resistance winding. Erratic reading—damaged resistance wire or slider.	If found defective, repair or install new control. Resolder red lead.

row at each end, the seventh is near the center of the horizontal side of the metal frame of set, and the eighth is near the center of the vertical side of the metal frame. Remove these screws, pull the set straight back, so the condenser shaft and volume control clear the cabinet and then lift the set up and rest it on top of the cabinet while removing the "local-distance" toggle switch from front of cabinet. Remove switch by loosening hexagonal nut with an open end wrench and unscrewing front knurled lock nut with fingers. Never use a wrench or pliers on the knurled nut.

Replacing Variable Condensers

If one variable condenser is defective, replace entire group of four variable condensers. Use pulleys and belts of original group.

Procedure: Remove set from cabinet. Loosen twelve screws holding variable condensers to metal frame. Note how pulleys and belts are arranged and then remove them. Replace one condenser at a time.

Remove the double R. F. transformers which are mounted on backs of variable condensers (do not unsolder transformer leads), at the same time removing the grid resistors, the grid condenser and the lugs of secondary leads, which are held to the condensers by the same nuts that hold the R. F. transformer brackets.

Remove the three screws holding first condenser, lift out the condenser and put in replacement without tightening screws. Mount the 1st R. F. transformer, the first grid resistor and the secondary lead lug, on the two bolts on back of the condenser. Make certain that the axes or long sides of the transformer coils are vertical. This may be checked by seeing that the sides of coils are parallel to the vertical metal strip on the back of the condenser.

Repeat procedure with each condenser and when all four are in place, put on the pulleys and belts, adjust belt tension and synchronize condensers (see Section XI).

Replacing R. F. Transformers

If one double R. F. transformer is defective, replace entire group of four R. F. transformers.

Procedure: Remove set from cabinet. In replacing Double R. F. transformers, substitute one transformer at a time, mounting and connecting the replacement exactly like the original. Do not mix up the old coils with the replacements.

Remove two nuts on back of first variable condenser which hold R. F. transformer brackets, unsolder transformer connections and remove old transformer Put replacement transformer in position, seeing that the grid resistor and lug of secondary lead are replaced properly, and tighten the two nuts. The transformer angle brackets must be arranged so that the axis or long side of the coil is vertical. This may be checked by seeing that the long sides of the coils are parallel to the vertical metal strip on the back of the variable condenser. Solder leads exactly like the original.

Repeat procedure with each R. F. transformer.

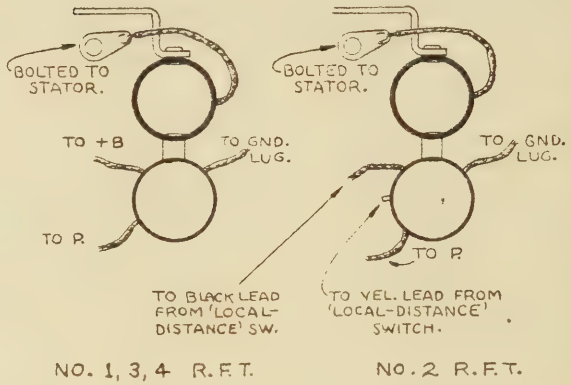


FIG. 74. SKETCH SHOWING CONNECTIONS FROM R. F. TRANSFORMERS

Replacing Volume Control

Remove chassis from cabinet.

The volume control is held to the metal frame by two screws and nuts and is mounted in such a way that the three terminals are on the right hand side when looking at the chassis in its normal position. Remove the two screws, using a long-nose pliers to grip the bottom nut, which is close to the second A. F. transformer.

A yellow lead connects the top one of the three terminals to the inside end of the antenna coupling transformer.

A red lead connects the bottom one of the three terminals to the tap on the antenna coupling transformer.

A green lead runs from the center terminal (slider contact) to a (ground) lug held under the right hand bolt that clamps the fourth R. F. socket to the metal frame.

The lead from the antenna post runs through a braided metal shield and is soldered to the lower one of the three terminals on the volume control. The metal braid is clamped to the center one of the three terminals. The other end of the metal braid is clamped to the ground post.

(The outside end of the antenna coupling transformer is connected to the grid contact of the first R. F. socket).

Inspect the volume control carefully. If the resistance unit is damaged, replace with latest style resistance unit. Bend the slider so it makes firm contact with the resistance wire. Clean the contact end of the slider and the top edge of the resistance unit. See that slider is of latest type.

Power Units in Models 40, 42, 44 and 52 Sets

Power units in Models 40, 42, 44 and 52 are very much like the later type "Y," the 37 and the 38 power units, the greatest difference being that all parts, with the exception of the panel assembly and tube socket, are sealed in a single container. The grid bias resistances are wound on a long strip instead of in two small separate sections. Models 42, 44 and 52 also have a regulating or ballast resistance in series with the primary of the power transformer. This resistance automatically compensates for line voltage variations and fluctuations.

Removing Power Unit from Cabinet

The power units in Models 40, 42, 44 and 52 receiving sets are sealed in a single metal container which is fastened inside the set cabinet by two screws at each end of the bottom and three screws at the top of the back. The rectifier tube socket is mounted on an angle bracket at the left hand end of the power unit. The panel assembly is fastened to the unit by two bolts and nuts which pass through the grid bias resistance strip. One of these bolts is the ground terminal.

Remove the cover or lid of the power unit (it is not screwed down) and release the cable connection panel from the panel assembly. Then remove set chassis from the cabinet. (See instructions for removing 40, 42, 44 and 52 receiving sets from cabinets). Loosen hexagon nut on A. C. toggle switch and unscrew front knurled lock nut with fingers. Note that the leads to the toggle switch come from the right, so that the switch is "on" when the toggle is thrown to the right.

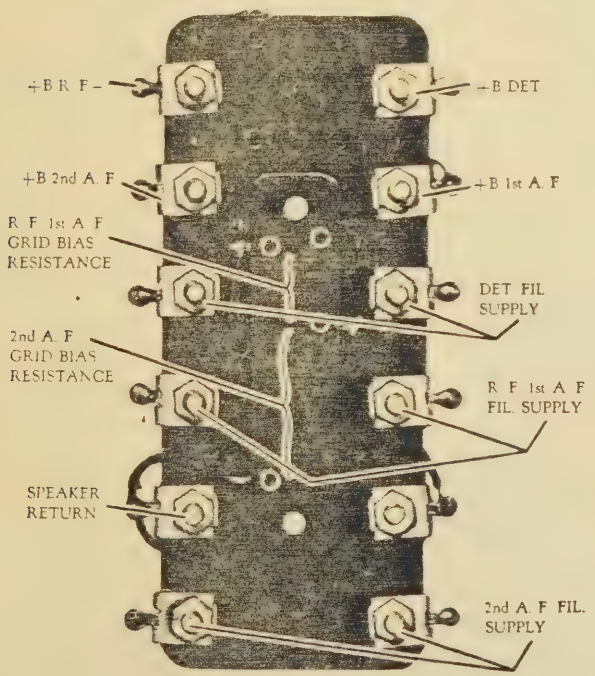


Fig. 75. Top View of Panel Assembly Used in Power Unit of Models 40, 42, 44 and 52

Remove screws holding power unit and remove two screws on strap which holds the 110 volt cable and the switch leads. The power unit may then be lifted out, pulling the 110-volt cable through the hole in cabinet.

In Model 52 the four nuts on the bolts holding the bottom of the power unit to the shelf of the cabinet are rather inaccessible unless the rear grill is removed. Or, if desired, one person may hold the nuts with a hexagon wrench while another turns the screws.

Testing

Apply the continuity tests given in the table on the following page. If the tests indicate that one of the resistances is defective, it may be replaced. If anything is defective in the power transformer chokes or condensers (which are all sealed as a unit in the metal container), remove the lid of unit, the panel assembly, the toggle switch, the cable, the regulating resistance, and the rectifier tube socket, substitute a new sealed container for the defective one and connect the panel assembly, switch, cable, regulating resistance and socket to the new sealed container exactly like the original.

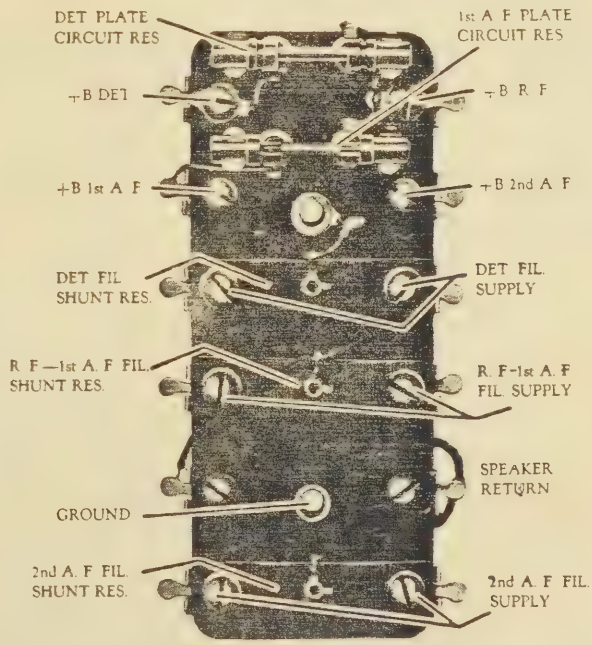


Fig. 76. Bottom View of Panel Assembly Used in Power Unit of Models 40, 42, 44 and 52

The terminal at the left of the ground eyelet (in this view) is used as a junction point for the lead from the centre-tap of the R.F. 1st A.F. filament shunt resistance, and the blue (red in some models) lead from the 1st A.F. by-pass condenser. This terminal is not connected to the set.

Continuity Test Table—Power Unit for Models 40, 42, 44 and 52

For Following Tests Remove Cable Connection Panel from Unit

TEST	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
Across 2nd A.F. Filament Supply.	*Full*	None—Open 2nd A.F. fil. winding and open 2nd A.F. filament shunt resistance.	Nearly full—open filament winding. (Unsolder one fil. winding connection and test winding and fil. shunt resistance separately.)
Across R.F.-1st A.F. Filament Supply.	*Full*	None—Open R.F.-1st A.F. fil. winding and open R.F.-1st A.F. fil. shunt res.	Nearly full—open filament winding. (Unsolder one fil. winding connection and test winding and fil. shunt resistance separately.)
Across Detector Filament Supply.	*Full*	None—Open det. fil. winding and open detector filament shunt resistance.	Nearly full—open filament winding. (Unsolder one fil. winding connection and test winding and fil. shunt resistance separately.)
FROM +B R.F. to			
+B 2nd A.F.	*Partial*	None—Open speaker (output) choke.	Full—Shorted speaker choke.
+B 1st A.F.	*Small*	None—Open 1st A.F. plate circuit res.	
+B Detector.	*Very Small*	None—Open detector plate circuit res.	
Ground.	*None*	Shorted filter condenser.	
F1 (on Rectifier Tube Socket.)	*Partial*	None—Open plate supply filter choke.	
FROM GROUND to			
+B Detector.	*None*	Shorted by-pass condenser.	
One Side of 2nd A.F. Filament Supply.	*Partial*	None—Open 2nd A.F. grid bias resistance.	Full—Shorted bias resistance.
One Side of R.F.-1st A.F. Filament Supply.	*Partial*	None—Open R.F.-1st A.F. grid bias resis.	Full—Shorted bias resistance.
One Side of Detector Filament Supply.	*Full*	Open connection to center-tap of detector filament shunt resistance.	Examine connections under panel assembly.
+B 1st A.F.	*None*	Shorted by-pass condenser.	
P1, P2 (on Rectifier Tube Socket.)	*Nearly Full*	None—Open high voltage sec. winding.	
Each Terminal of A.C. Plug.	*None*	Grounded primary of power transformer.	Inspect A.C. cable and switch leads for accidental grounds.
OTHER TESTS			
Across Terminals of A. C. Plug. (Toggle Switch "On.")	*Full*	Open primary of transformer or open cable or switch leads.	
F1 to F2 (on Rectifier Tube Socket.)	*Full*	Open rectifier filament winding or connections.	
One Side of 2nd A.F. Filament Supply to Speaker Return Terminal.	*Full*	Open connection to center-tap of 2nd A.F. filament shunt resistance.	

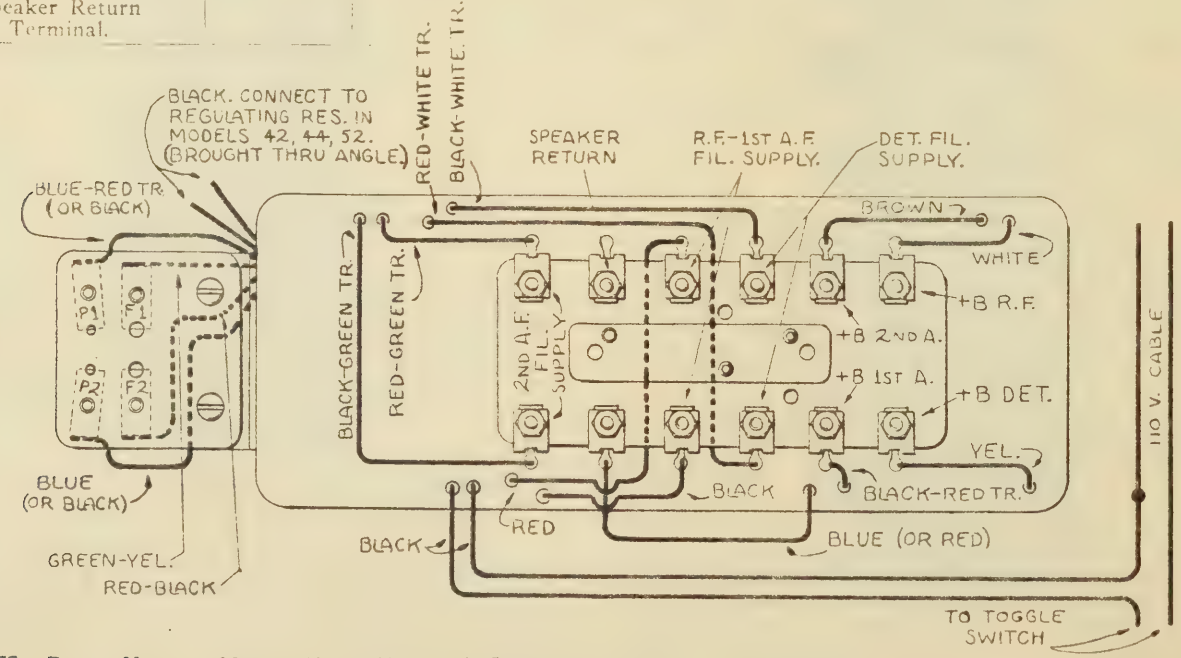


FIG. 77. POWER UNIT IN MODELS 40, 42, 44 AND 52, SHOWING CONNECTIONS FROM SEALED CONTAINER TO PANEL ASSEMBLY, RECTIFIER SOCKET AND REGULATING RESISTANCE

This view shows the approximate position of leads from sealed container. In Models 42, 44 and 52, a hole is cut in the rectifier-socket mounting angle and the two black leads are brought up through the hole and connect to the regulating resistance, which is mounted upright at the left hand end of the sealed container.

Voltage Test Chart

Atwater Kent A. C. Sets

(Measurements made while set is in operation)

FIL. VOLTAGES (Use 0-5 A. C. meter)	TEST TERMINALS (Colors of cable leads)	Model 36 Model 37 to Serial No. 1,265,000	Model 37, Serial No. 1,265,001 to 1,385,000	Model 37, Serial No. 1,385,001 and up	Model 38	Models 40, 42, 44 and 52.	Model	Model	Model	Model
		APPROXIMATE VOLTAGE								
Detector	Red-white tr. to black-white tr.	2.3	2.2	2.3	2.3	2.35				
R. F. & 1st A. F.	Red to black	1.4	1.45	1.3	1.3	1.45				
Power (2nd A. F.)	Red-green tr. to black-green tr.	4.8	4.7	4.8	4.8	4.8				
PLATE VOLTAGES (Use high resistance D. C. meter)										
Detector	Red-white tr. to yellow.	30	25	30	48	44				
R. F.	Red to any R. F. tube "P" contact (thru eyelet).	135	165	170	180	160				
1st A. F.	Red to black—red tr.	110	135	160	160	155				
Power (2nd A. F.)	Red-green tr. to brown.	120	145	175	180	180				
BIAS VOLTAGES (Use high resistance D. C. meter)										
On Power tube	F to G (socket 2A, thru eyelets).	25	30	45	45	45				
On R. F. and 1st A. F. tubes	F to G (socket 1A, thru eyelets).	12	12	13	13	13				

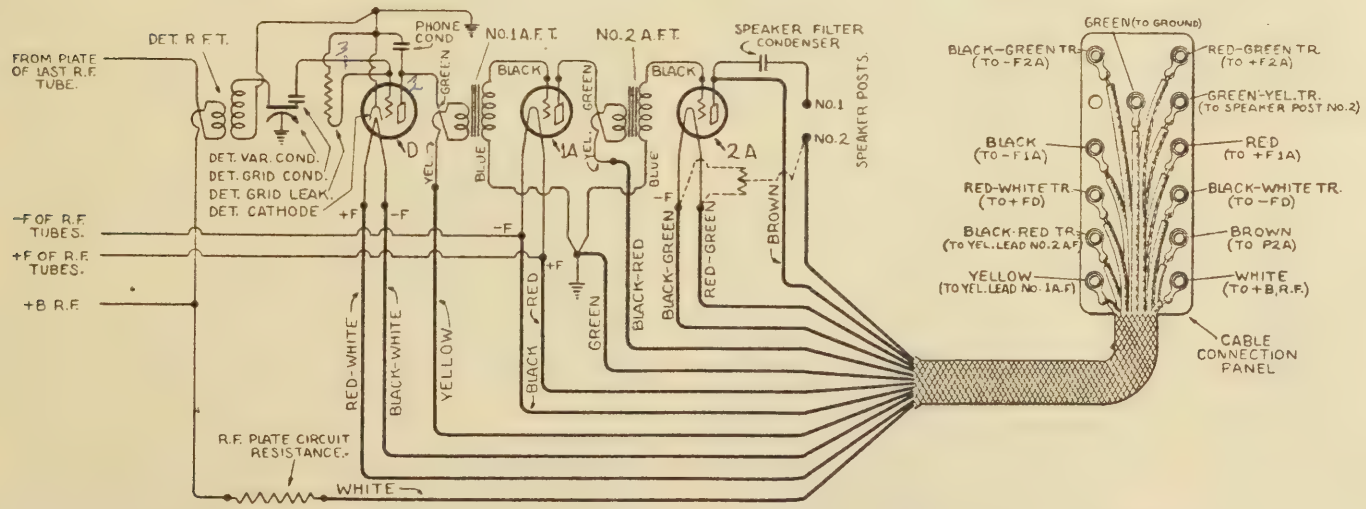


FIG. 78. DETECTOR AND TWO STAGE AUDIO FREQUENCY AMPLIFYING CIRCUIT USED IN LATER MODEL 36, AND IN MODELS 37, 38, 40, 42, 44 AND 52

The 2nd A. F. filament shunt resistance (shown in dotted lines) is used in all Model 36 sets and in many Models 37 and 38. In later Models 37 and 38, and in Models 40, 42, 44 and 52, this resistance is not used in the set, but the 2nd A. F. filament shunt resistance in the power unit is used for the same purpose, a green-yellow tracer lead connecting speaker post No. 2 to the centre tap of the 2nd A. F. filament shunt resistance in the power unit. In Model 36, and in Model 37 console sets, the two terminals on either side of the ground eyelet are used for toggle switch connection in the 110 volt line. In some Model 36 sets a green-yellow tracer lead is used instead of a black-red tracer lead for connection to the yellow lead of the 2nd A. F. T. The R. F. plate circuit resistance is not used in Model 36 nor in some 37 and 38 sets. Except for these minor variations, this circuit is standard in these sets, and the service man should remember the color scheme of A. F. transformers and the colors of cable leads and their location on the connection panel.

SECTION VII

SERVICING THE "B" POWER UNIT

1. General Description

This unit is designed to replace the usual dry or wet "B" batteries as a source of plate current supply, taking its power from the 110-volt, A.C. house-lighting system and converting it into direct current of sufficient voltage for the plate requirements of a standard set. The operation of this device is, briefly, as follows:

The first step in transforming the A.C. to D.C. at required voltages, is to raise or "step up" the 110 volts to the necessary value for plate supply, taking into consideration the losses to be encountered in the later necessary processes of rectifying and filtering the current. This step-up is accomplished by the use of a transformer, which is designed so as to deliver about 500 volts at the secondary terminals.

The next step is the changing of the higher voltage alternating current delivered by the transformer to a current in one direction, and this is done by means of a special design tube known as a rectifying tube. This changes the A.C. into pulsating direct current, current in one direction, rising and falling between zero and maximum.

The rectification effect produced by the tube in the "B" Power Unit is somewhat the same as that produced by the detector tube of the radio set; however, the construction of the tube is quite different. No filament is used, there being, however, three electrodes, two of these being single, straight vertical wires and the third a double cylindrical grid of fine wire surrounding the other two. The form of the grid resembles on a small scale that of the double coil used as the R. F. transformer on some of our receivers. A rare metal is used in the construction of both the straight electrodes and the grid. The tube is filled with a specially purified rare gas under reduced pressure. (See Fig. 79.)

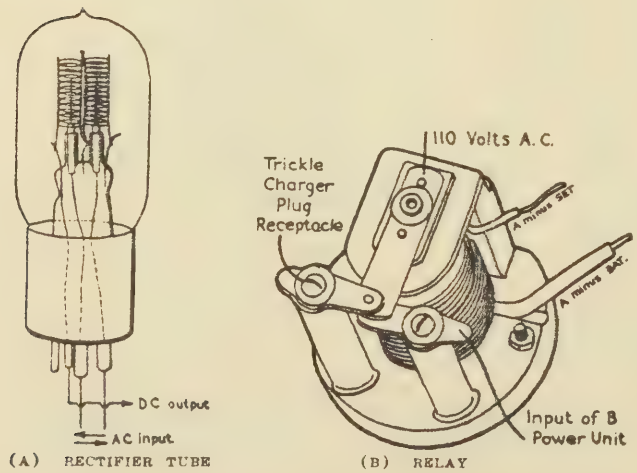


FIG. 79. TWO ELEMENTS OF "B" POWER UNIT.

Due to peculiar properties of the internal elements making up the tube, the gas will conduct current freely when flowing from either of the straight electrodes to the grid, but it acts practically as an insulator for a current in the opposite direction.

The two straight electrodes are connected to the secondary terminals of the step-up transformer, while a wire connected to the cylindrical grid leads to the "load" (filters, resistances and B circuit of the set), the return wire from the load running to a center tap on the transformer secondary. Connection is obtained to the three elements of the tube by having it fitted with a standard UX type base, one of the four prongs being unused. A better understanding of the circuit described above will be had by referring to the schematic diagram furnished in this section (Figs. 80 and 82).

The pulsating direct current delivered by the rectifying tube is not suitable for plate supply, so it is necessary to "filter" or smooth out this current to give an even flow. This is done by means of a special arrangement of choke-coils and condensers, the connection layout and values of these individual parts having been determined after extended laboratory experiments. (See illustration Fig. 82.)

We now have an even flow of direct current and all that remains to be done is to distribute this current to the various plate circuits of the radio set at the proper values for maximum performance. A set of resistances and by-pass condensers is used to accomplish this. Binding posts are provided on the panel of the "B" Power Unit properly marked for connection to the correct cable terminals of the set.

The Atwater Kent "B" Power Unit includes a plug receptacle for connecting a trickle charger to use in keeping the A storage battery charged. The plug from the trickle charger is placed in this receptacle and by means of a "relay" incorporated in the "B" Power Unit, the 110-volt current which is supplied to the "B" Power Unit is automatically transferred to the trickle charger when the radio set is turned off by the switch button on the panel.

The relay is in effect an automatic single-pole double-throw switch directly controlled by the filament switch on the radio set. It consists of a coil of wire with a soft iron core, an armature being supported over the core and carrying a contact spring which is insulated from it (the armature). Two other contact points are mounted, one above and one below the contact spring so as to make and break with the two corresponding points on the spring itself when the relay operates. (See Fig. 79.)

The magnet coil is connected in series with the "A" battery or filament circuit of the set. The contact spring is connected (thru the plug of the "B" Power Unit) with one side of the 110-volt, A.C. supply. The

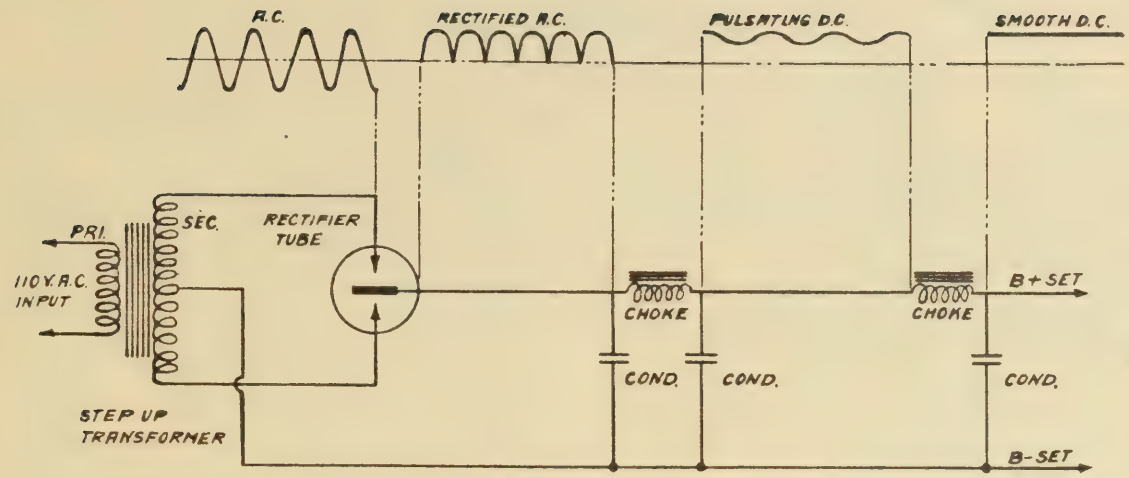


FIG. 80. STEPS IN PROCESS OF RECTIFICATION OF CURRENT BY "B"-POWER UNIT.

upper contact point is connected to one terminal of the trickle charger receptacle and the lower to one side of the input of the "B" Power Unit. The two remaining terminals—one of the trickle charger receptacle and the other of the "B" Unit input—are permanently connected to the other side of the 110-volt, A.C. line. The operation is as follows:

When the radio set is turned on, the coil is magnetized by the "A" battery current passing thru it, causing the armature (carrying contact spring) to be drawn down to make contact with the lower point, thereby closing input circuit to "B" power unit. When the set is turned off, the armature is automatically released by the coil losing its magnetism. The contact spring then touches the upper contact point, sending the 110-volt current thru the trickle charger, which has been connected in the circuit by placing its plug in the receptacle at front of "B" Power Unit.

2. Determining if "B" Power Unit is at Fault

When radio reception is unsatisfactory, and it is felt that the "B" Power Unit may be at fault, it is advisable to first check up on the other accessories used, testing the tubes, A and C batteries, checking connections at A battery terminals, and examining aerial, ground and speaker.

If these accessories all test O. K., it would then be a good plan to temporarily substitute a good set of 45 volt dry B batteries for the "B" Power Unit, which will readily indicate whether the latter has been functioning normally. If this test shows that the "B" Unit may be "dead," a new rectifier tube should first be tried out, as occasionally some trouble may develop in this part. The replacement of the tube will of course correct this, and the defective one should be returned to the distributor.

3. Measuring Voltage of "B" Unit

Another way of determining if the "B" unit is defective is to measure the output voltage while the unit is connected to a receiving set in operation. Measurement should be made with a high resistance D. C. voltmeter. The following approximate voltages should be obtained on a line voltage of 110-115 A. C., assuming a standard six tube set is being used, with a power tube in the last audio socket.

Measure from B minus to	Approximate Voltage
B + PWR	135
B + AMP (Post No. 2 or 3)	70
B + DET	25

If the voltages are considerably different from the values given above, or if no voltage is obtained from B— to each of the B+ terminals, some part of the "B" unit is probably defective, and it will therefore be necessary to dis-assemble the unit.

4. Taking the Unit Apart

Remove the cover by taking out the four machine screws around sides, then remove the four "feet" by taking out screws in them and also remove the single screw from bottom of case. Next remove the screws which hold the bakelite binding post panel to the metal case and also the two which hold the receptacle for plug from trickle charger. The entire unit can then be lifted out of the case, after pushing the panel and plug receptacle inside so that they will not catch as the assembly is being lifted up and out.

5. Continuity Tests

Using the regular testing equipment, consisting of a 45 volt "B" battery and a 0-50 voltmeter, make the tests given in the accompanying test table.

If the test indicates that a section or block of the unit is defective, that section should be replaced and returned to the distributor.

6. Possible Troubles

Condition.	Cause
No reception	Shorted condenser, open choke coil, open primary of transformer.
Noisy reception (crackling)	Defective rectifier tube.
Intermittent reception. (When "B" unit is shaken)	Poor contact of tube in socket, half-broken lead or connection.
Sluggish starting of receiver to function	Defective rectifier tube, dirty or burned relay contacts.
Noticeable darkening of glass of rectifier tube	Defective tube.
Abnormal heating in "B" unit	Shorted turns in transformer.
Excessive hum	One side of secondary open.

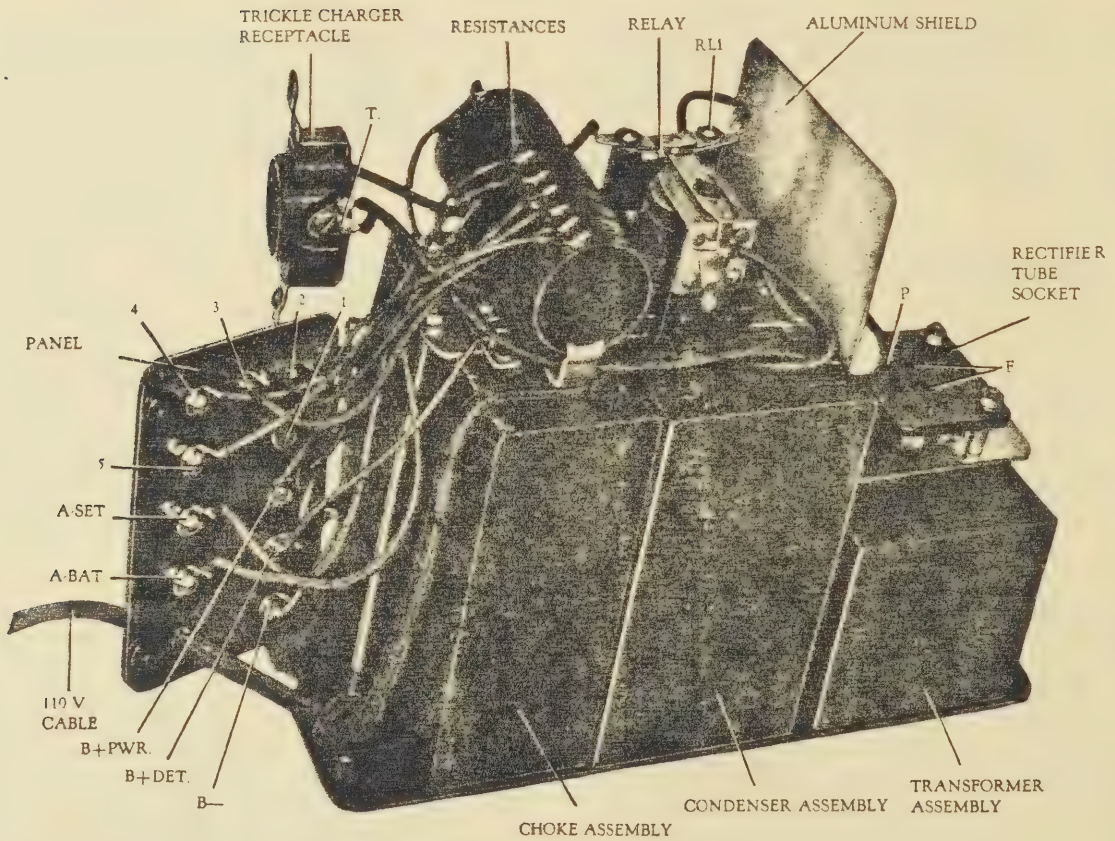


FIG. 81. VIEW OF "B" POWER UNIT.

Wiring Diagram and Test Table for "B" Power Unit

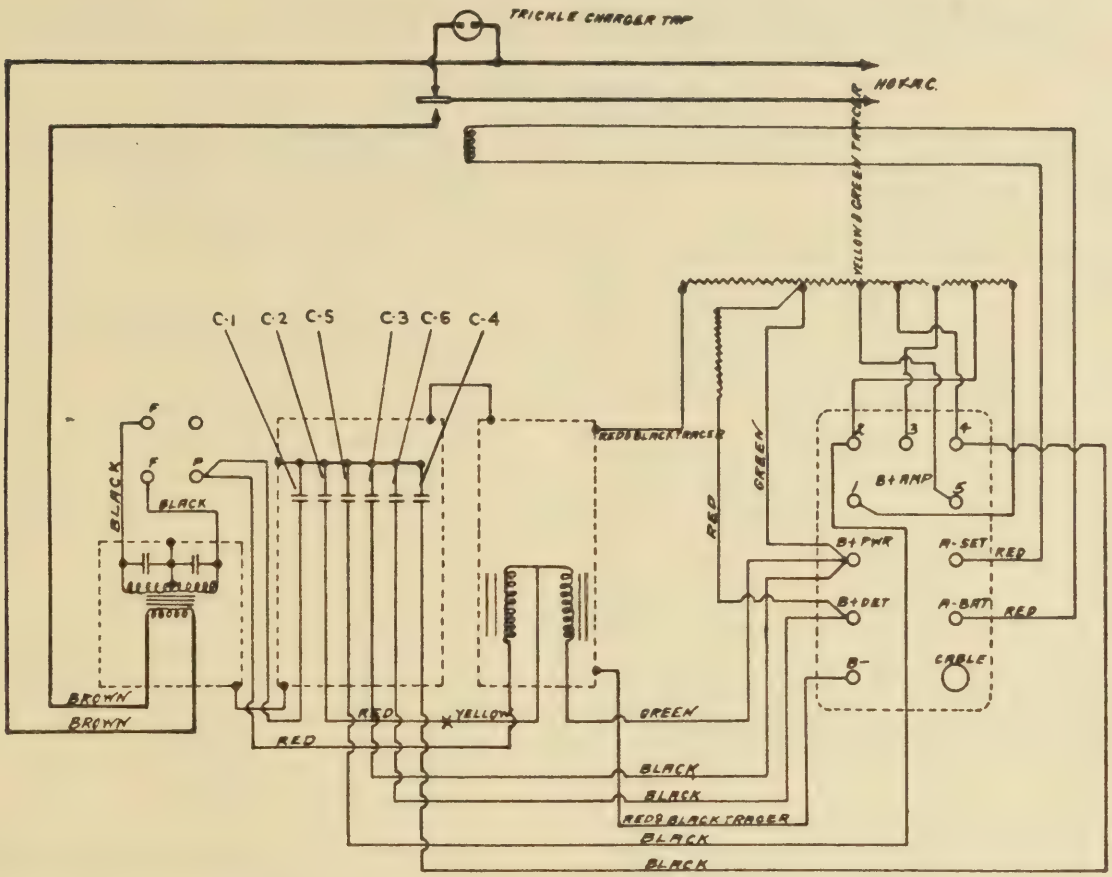


FIG. 82. B-POWER UNIT. MODEL R No. 8800 (Wiring Diagram).

NOTE.—In Model "S" Unit for 25-cycle A. C. Power, Condenser C-5 is Connected to Post 3 of "B plus AMP," and Condenser C-4 is Omitted.

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
B— to			
Exposed Portion of Three Metal Containers.	*Full*	Open ground connection.	See that ground straps are soldered together.
B+ PWR.	*Partial*	None—Open regulating resistance.	Full—Shorted filter condenser or grounded choke.
B+ AMP. (Taps Nos. 1, 2, 3, 4, 5).	*Partial*	None—Open resistance.	Reading should increase slightly from 1 to 5.
B+ DET.	*Small*	None—Open detector plate circuit resistance.	Full Reading—Shorted by-pass condenser.
A— BAT.	*None*	Grounded relay coil circuit.	
Both Terminals of A.C. Plug.	*None*	Grounded primary circuit of power trans.	
Each of Two Large Holes on Rectifier Socket.	*Nearly Full*	Open connection sec. of power transformer.	
OTHER TESTS			
RL1 to Point "T" on Trickle Charger Receptacle.	*Full*	Open primary of power transformer.	**NOTE:** In case any one of the filter or by-pass condensers is thought to be defective, its connecting lead should be unsoldered from the rest of the circuit and the condenser tested separately for possible short circuit. The filter chokes may be tested in the same manner.
Across Two Large Holes on Rectifier Tube Socket.	*Nearly Full*	None—Open secondary of power trans.	
B+ PWR. to Contact "P" (on Rectifier Tube Socket.)	*Partial*	None—Open filter choke coil.	
A— Set to A— Bat.	*Full*	Open relay coil circuit.	

SECTION VIII

CHART OF TROUBLES AND PROBABLE CAUSES

A—Battery Sets Only

1. Tubes fail to light

1. A battery discharged.
2. Badly corroded A battery terminal.
3. Burned out or open rheostat.
4. Broken filament lead in cable.
5. Defective filament switch.
6. Defective tubes.

2. Tubes light, no reception

1. B voltage supply dead or defective.
2. Open in B lead in cable.
3. Incorrect B connections.
4. A battery connections reversed.
5. Open primary of transformer (A. F. or R. F.).
6. Shorted grid condenser.
7. Open coil in speaker.
8. Defective tube.
9. Shorted by-pass condenser.

3. Disturbing noises (occurring with antenna and ground disconnected)

1. Run-down or defective B battery.
2. Defective B power unit.
3. Poor connection at A battery terminal.
4. Loose connection to B supply.
5. Defective phone condenser.
6. Defective audio transformer.
7. Defective speaker cord.
8. Defective by-pass condenser.

4. Distorted tone

1. Interference (two stations on same frequency).
2. Batteries exhausted.
3. Speaker out of adjustment.
4. Incorrect C voltage.
5. C battery disconnected.
6. B power unit incorrectly connected or adjusted.

5. Intermittent reception

1. "Fading" due to atmospheric conditions.
2. Antenna or lead-in touching grounded object.
3. Loose or corroded connection in fil. circuit.
4. Defective grid leak.
5. Loose connection in set or cable.
6. Local receiving set interfering.

6. Continuous whistle or hum

1. Microphonic tube.
2. Speaker too close to set.
3. Defective B power unit.
4. Low Detector B voltage.
5. Heterodyne.
6. Open grid circuit (detector).
7. Grounded A. F. transformer.
8. Open antenna choke.

7. Reception weak

1. Defective tube.
2. A or B voltage low.
3. Poor location.
4. Defective battery connections.
5. Weak audio transformer.
6. Grid resistance open.
7. Secondary R. F. transformer open.
8. Condensers poorly synchronized.
9. Defective grid leak.

B—A. C. Sets Only

1. All tubes fail to light	1. Line voltage D. C. instead of A. C. 2. Open primary power transformer. 3. Open lead in A. C. plug cord.
2. One or several tubes fail to light	1. Defective tube. 2. Open secondary of power trans. low voltage. 3. Open wire to filament circuit.
3. Tubes light, no reception	1. Defective rectifier (or other) tube. 2. Open secondary power trans. (high voltage). 3. Shorted condenser in power unit. 4. Open choke in power unit. 5. Open plate voltage resistor. 6. Shorted speaker choke. 7. Defective audio. trans. (open primary).
4. Reception weak	1. Shorted primary transformer. 2. Shorted secondary power transformer. 3. Defective rectifier tube. 4. Same causes as under battery sets except first four.
5. Distorted tone	1. Shorted primary power transformer. 2. Shorted secondary power transformer high or low voltage. 3. Defective rectifier tube. 4. Open biasing resistance. 5. Speaker out of adjustment. 6. Shorted biasing resistance.
6. Intermittent reception	1. Defective rectifier tube (loose filament). 2. Open biasing resistance. 3. Loose connection in power unit. 4. Same reasons as under battery sets.
7. Continuous hum	1. Secondary power transformer open (one side, high voltage). 2. Open ground on secondary. 3. Shorted filter choke (power unit). 4. Open filament shunting resistance. 5. Same causes as under battery sets (except No. 3).
8. Overheating	1. Shorted primary power transformer. 2. Shorted secondary winding or circuit.
9. Disturbing noises	1. Induction thru A. C. power lines. 2. Loose connection in power unit. 3. Causes 5-6-7 under battery sets (A, 3).

C—Both, A. C. and Battery Sets

1. Oscillation	1. Defective ground connection. 2. Unsuitable R. F. tubes. 3. Grid resistance shorted. 4. Excessive R. F. plate voltage. 5. Open secondary R. F. transformer. 6. R. F. by-pass poorly grounded. 7. Antenna lead too close to set (wood cabinet sets).

SECTION IX
TROUBLES MOST FREQUENTLY ENCOUNTERED

A. In Either Type Set (Battery or A.C.)

CONDITION	CAUSE	SYMPTOMS	REMEDY
1. Grid resistance burned out.	Shorted tube.	Reception weak.	Replace resistance unit.
2. Audio Trans. primary open.	Electrolysis.	Reception dead.	Replace transformer.
3. Audio Trans. secondary open.	"	Distorted reception.	" "
4. Antenna choke burned out.	Shorted tube, No. 1 socket.	Reception weak; hum.	Replace antenna choke.
5. R. F. T. primary burned out.	Shorted tube.	Set dead or very weak.	Replace R. F. transformer assembly.
6. Condenser dial out of adjustment.	Dial slipped on shaft.	Incorrect dial setting.	Loosen set screw in dial knob and reset correctly—pointer at 100, with plates fully enmeshed.
7. Condenser rotor assembly out of adjustment (3-dial sets).	Rotor assembly loosened thru jarring.	Irregular dial settings.	Loosen set screws at ends of rotor tension spring and reset assembly so rotor plates are equally spaced from stationary.
8. Condenser pulley belts loose or broken.	Forcing of tuning dial.	Tuning dial does not control condensers.	Replace belt, removing set chassis from cabinet and condenser panel assembly from main panel to make belts accessible. (See Secs. VI and XI.)
9. Condensers out of synchronism.	Rough handling or jarring of set.	Lack of volume and selectivity.	Resynchronize condensers. (See Sec. XI.)
10. Leaky by-pass condenser.	Excessive "B" voltage or excessive humidity.	Weak reception, rapid "B" battery consumption, set fails to operate on "B" eliminator (battery sets).	Replace by-pass condensers. Use No. 8685 for replacement on all battery sets, except No. 4640 and No. 4880.
11. Shorted phone condenser.	Defect.	Noisy reception.	Replace phone condenser.
12. Open wire in power cable.	Indefinite.	Set dead or tubes fail to light.	Repair break or replace cable.
13. Defective grid leak.	Defect.	Reception choked.	Replace leak.

B. In A.C. Sets Only

1. Volume control burned out.	Shorted tube.	Volume can't be reduced.	Replace resistance unit.
2. Volume control noisy.	Resist. wire spread unevenly or slider coated with oil or not pressing hard on resistance wire.	Volume knob does not turn smoothly or turns too smoothly.	Replace resistance unit or clean slider and resistance and bend slider to make better contact with wire. Use latest type of slider and resistance unit.
3. Power transformer pri. open.	Indefinite.	No voltage—set dead.	Replace transformer assembly.
4. Power transformer pri. shorted.	"	Overheating—set weak.	" " "
5. Power transformer sec. open (high voltage winding).	"	Reception weak —hum.	" " "
6. Power transformer sec. open (low voltage winding).	"	One or more tubes fail to light.	" " "
7. Shorted condenser (power unit).	"	No reception.	Replace condenser-choke assembly (on Models 36, 37, 38).
8. Open choke (power unit).	"	No reception.	Replace condenser-choke assembly (on Models 36, 37, 38).
9. Open "B" voltage resistance (detector or No. 1 A. F.).	"	Reception very weak or none at all.	Replace resistance unit (tubular, under small panel top of power unit).
10. Open biasing resistance (226 or 171).	"	Distortion and blocking—hum.	Replace biasing resistance.
11. Defective rectifier tube.	"	Weak, irregular or distorted reception.	Replace tube.
12. Loose power transformer laminations.	"	Hum audible to ear.	Replace transformer (Models 36, 37, 38).

Note—A defect in the transformer, condensers or chokes, in the case of A. C. sets having a single sealed power unit container, will necessitate replacement of the sealed container.

Section X

SERVICING ATWATER KENT SPEAKERS

General Description

1. Horn Type

The sound unit of the Atwater Kent horn type speaker consists of a powerful permanent magnet similar to a horseshoe magnet, mounted at the end of a short cylindrical metal chamber. The two poles of the magnet have extension pieces, each of these being wound with a coil of very fine wire. These two coils are connected in series and also thru the speaker cable and plate circuit of the last tube of the radio set.

A diaphragm in the form of a circular disc of special alloy metal, carefully mounted between rubber gaskets, is suspended so that its surface rests but a small fraction of an inch above the extension pole pieces of the magnet.

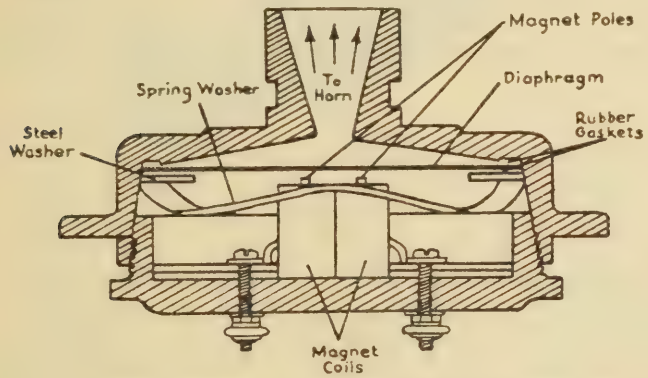


Fig. 83. Cross Section View of Sound Unit (Horn Type).

The action of the unit is as follows:—When a radio signal enters the receiving set, as explained under Section I "Theory of Radio Receivers," it causes fluctuations or changes in the flow of current in the plate circuit. Since the magnet coils of the speaker unit are in series with the plate circuit, these changes in current will pass thru these coils, and this in turn will cause variations in the pull of the permanent magnet on the diaphragm. Accordingly the diaphragm vibrates, and in doing so, causes sound vibrations which pass thru the air column of the horn into the room to the listeners' ears, an almost perfect reproduction of the sound at the microphone of the broadcast station.

2. Cone Type (Models "E" and "E-2")

The Models "E" and "E-2" Speakers are of the "free-edge" cone type, and differ in many respects from other cone speakers on the market.

The magnet is a powerful double one, and the vibrating element a thin rectangular reed of special alloy steel, mounted so that one end can vibrate freely between two of the four poles of the magnet. A single magnet coil is mounted so as to surround and enclose the reed without touching it, and the current in the plate circuit of the radio set passes thru this coil.

The apex of the cone is attached directly to the reed by a novel spring mounting which supports the weight of the cone, but at the same time allows it complete freedom of motion.

As in the case of the horn-type speaker, the changes in the current from the set passing thru the coil of the speaker unit cause changes in the pull of the magnet on the reed, thus causing the reed and the cone attached to it to vibrate correspondingly. The cone vibrates the air directly, giving very lifelike reproduction.

Comparison Test

When an Atwater Kent speaker seems to be functioning imperfectly, it should first be tried out on reception in comparison with a speaker of similar type that is known to be good. If this comparison definitely indicates that the speaker is defective, it should be inspected and tested to determine the source of trouble.

Damaged Coil or Cord

If the speaker does not work at all, the trouble may be in an open magnet coil or an open cord. These may be tested with a voltmeter and battery. If the cord or the coil circuit is open, no reading will be secured on the meter. If the cord is damaged, or the connections half-broken, the meter will usually give an erratic reading when the cord is shaken.

In testing the coil, the voltmeter test points should be applied directly to the coil terminals on the sound unit. If the coil is open, the sound unit should be replaced. If the cord has an open lead it may sometimes be repaired satisfactorily, otherwise it should be replaced.

Detailed Service Information

1. Horn Type (including phonograph attachments)

A. Disassembling Horn Unit.

Remove gooseneck and horn from base of speaker, invert base and unscrew knurled cap all the way. Lift

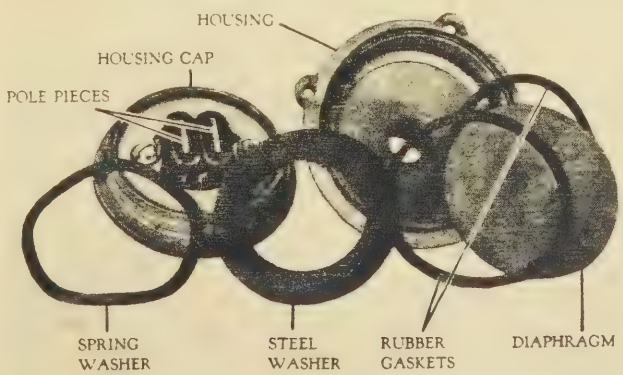


Fig. 84. Horn Type Unit, Disassembled.

out the bronze retaining spring, then the steel washer and the rubber gasket, then the diaphragm and second rubber gasket at bottom. These parts are indicated in Fig. 84.

B. Testing.

Test the coil and cord for continuity and then carefully inspect the other parts, looking for the following.

C. Possible Troubles.

1—Iron or other foreign particles on pole pieces. (Sometimes these particles are so small as to be hardly visible).
Remedy:—Pick off with a small sharp knife, working outward and upward from between the pole pieces.

2—Diaphragm bent, buckled or up-side down.
Remedy:—Replace diaphragm or assemble correctly.

3—Weak spring. Spring may give insufficient pressure against diaphragm, causing rattling on very loud signals.
Remedy:—Replace spring or bend so as to increase height of all four of the bends, making them all exactly the same height.

4—Rubber gaskets. If these show signs of deterioration they should be replaced. If new gaskets are used in reassembling the unit, each should be stretched to fit tightly in the housing. This may be done by holding the gasket by both forefingers and expanding it for a moment to a length of about eighteen inches, repeating this three or four times.

5—Weak magnet. Test with weight-scale in the following manner:

D. Testing Magnets in Horn Type Units.

Equipment for testing the strength of the sound unit magnet is very simple and inexpensive, consisting of a small spring-type weight scale, about 0-10 pounds,—(which may also be used in testing the cone type sound unit magnets) and a circular flat disc, ground absolutely flat, of soft iron (Swedish or "Armco" iron) about 1 inch in diameter and 1/16 inch thick. This disc should have a small central stud, carrying a hole, attached to the center of one of its sides. A loop of strong flexible string, about an inch or two in length, should be attached to the hole in the stud.

To test the strength of the magnet in a horn type sound unit, place the flat side of the disc centrally on the pole pieces, loop the string over the weight-scale hook and carefully exert a steady pull exactly along the axis of the unit until the magnet lets go. The position of the speaker and scale is shown clearly in the accompanying illustration, Fig. 85.

When pulling on the horn type sound unit, the disc "armature" should not be released until the scale registers a pull of about 4 pounds or more. Assuming that the weight-scale has been checked for accuracy, if the reading is appreciably less than 4 pounds, and if the speaker is noticeably weak in actual reception, the sound unit should be replaced.

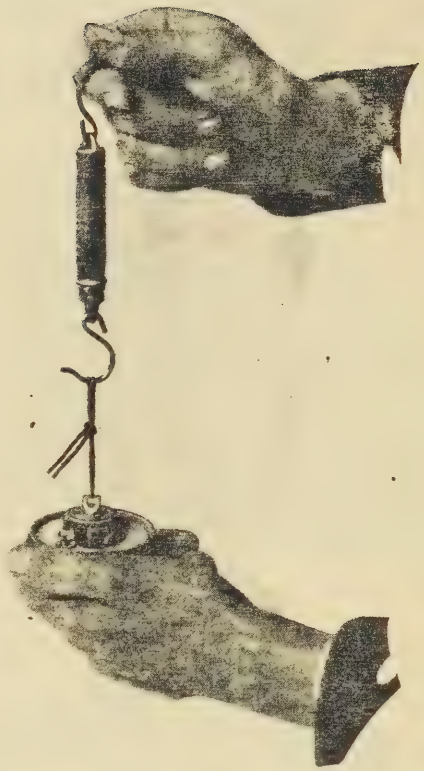


Fig. 85. Testing Magnet Strength, Horn Type Unit.

With time and use there is some unavoidable loss of magnetism in speaker magnets. But in general this decrease does not appreciably affect the performance of the speaker, so in all cases the final test should be in listening to actual reception. The magnetic strength tests are chiefly of value in eliminating one possible source of trouble.

After the unit has been carefully examined and tested, and any defective parts repaired or replaced, it may then be reassembled.

E. Assembling Horn Type Unit.

(1) RUBBER GASKET—place in its groove in housing and use the steel washer to press the gasket into place. The gasket should not fall out when the housing is inverted and shaken. The steel washer should, of course, be removed.

(2) DIAPHRAGM—center on the rubber gasket with the concaved side toward the horn. It is very important that the diaphragm should be placed with the concaved or hollow side facing the horn opening. Instructions to this effect are rubber-stamped on the concaved side of each diaphragm. Also it is extremely important that the diaphragm should be centered perfectly on the rubber gasket and that it does not touch the metal housing at any point, otherwise the diaphragm will rattle.

(3) RUBBER GASKET—place over the diaphragm and press into position with the steel washer, taking care not to disturb the diaphragm setting.

(4) STEEL WASHER—place over the rubber gasket with the concaved or hollow side facing the diaphragm. The concaved side of the steel washer may be found by laying a straight edge across the face of the washer and holding both up to the light.

(5) BRONZE SPRING WASHER—place in housing over the steel washer.

(6) HOUSING CAP—screw clockwise on housing.

F. Adjusting the Horn Speaker.

The speaker should be adjusted during reception of a strong and clear broadcast station. Screw up the knurled housing cap clockwise until the diaphragm snaps against the pole pieces, causing reception to become weak and rattling. It should then be unscrewed until a click occurs and reception comes out clear and normal, the best adjustment being as close (turned clockwise) as possible without rattling on a strong signal

It is necessary to have the horn type speaker leads connected to the receiving set in the proper manner, which is clearly specified on the Atwater Kent horn type sound units and also on the Atwater Kent battery-type radio receivers.

2. Free Edge Cone Type (Models E and E-2)

The Atwater Kent Model E and Model E-2 Speakers are of the free edge cone type. Their construction is much more rugged than that of the average cone, so that repairs are seldom required. All steel parts are thoroughly rust-proofed, and both the coil windings and the cone itself are impregnated with moisture-proofing compound.

The sound unit used in these speakers as now manufactured, is enclosed in a dust-proof rubberized bag which protects the unit from iron particles and dust.

In order to examine and test the parts, it is necessary to disassemble the speaker. Instructions for doing this and instructions for testing, repairing and assembling this type of speaker are given below.

A. Disassembling the "Type E" Speaker.

(1) Removing Grill.

Remove the four screws around the outer housing of speaker, then remove the front (grill) in this way:

Stand the speaker on a firm table, place a double fold of heavy cloth over the top of the grill of the housing, hook the thumb of the left hand under the top edge of the grill, with the other fingers of the left hand pressing down on the top of the housing, and then, through the cloth, hit the top of the edge of the grill several sharp blows with a hammer, at the same time pulling forward with the thumb. The vibrational effect of the hammer blows tends to loosen the grill from the housing, while the steady pull with the thumb tends to move the grill forward and off the housing. The cloth is used to protect the finish of the grill, which would otherwise be marred by the hammer blows. In removing the grill, be careful not to let it hit against the cone.

(2) Removing Cone.

The cone is attached to the flat reed spring by a small bolt and nut. Two special wrenches (Part No. 9255) should be used in removing this bolt, the illustration, Fig. 86, showing how this should be done. Hold the cone by the small metal bracket at its apex and pull straight off from the reed spring.

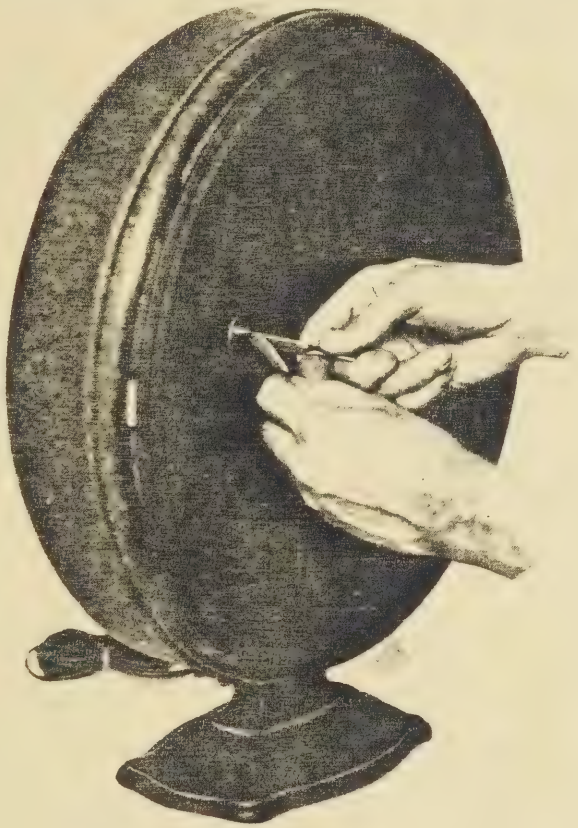


FIG. 86. REMOVING CONE, MODELS E AND E-2.

(3) Removing Sound Unit.

The sound unit is removed by unscrewing the two acorn nuts at the rear of the housing. Note how the cord is brought over the top and in back of the sound unit down to the small hole at the rear of the housing. When assembling the speaker, the cord should be arranged in the same way. In handling the sound unit be very careful not to strain the flat reed spring.

B. Possible Troubles.

1. OPEN COIL OR CORD—test with voltmeter and battery for continuity. Replace if found defective.

2. DAMAGED CONE—examine carefully for cracks and bends, especially around the apex. If no defect is found, hold the cone horizontally with hollow side up about 3 or 4 inches above a firm wood-topped table and then drop so that the apex will hit the table. If the cone is in satisfactory condition it will strike with a clear resonant "knock" rather than a dull, lifeless thump or thud. Replace cone if it seems to be defective.

3. METAL CHIPS ON POLE PIECES—carefully remove the dust-proof bag from the sound unit and examine the air-spaces between the reed and pole pieces to determine whether iron or other particles (caught up by the attraction of the magnets) are clogging up the air-spaces between reed and pole pieces and consequently interfering with free motion of the reed. If such a condition is found, it is sometimes possible to remove the particles, although usually it is advisable to replace the unit.

4. IMPERFECTLY ADJUSTED SOUND UNIT—examine the sound unit to see if the reed is adjusted centrally between the pole pieces so that the air-spaces at each side are equal. If the reed is not centered correctly, the unit should be replaced, although in exceptional cases a qualified service man may adjust the reed.

Adjustment of the reed is made through the two screws which pass through the magnet and bear on the reed. By loosening one screw and tightening the other, the reed may be moved to either side. When the reed has been adjusted exactly to the center the two screws should be tightened alternately little by little, until both are tight.

The adjustment may be tested by clasping the reed spring, near the reed, between the thumb and forefinger and pushing and pulling so as to cause reed to snap against either pole piece. The same force should be required to move the reed in each direction. If the unit is properly adjusted see that the air-spaces are free from chips and then carefully replace the dust-proof bag.

5. LOOSE NAME PLATE OR SERIAL PLATE—Suspend the grill by one hand and with the wood handle of a screw driver sharply tap the grill near the name plate. Listen carefully and if a "tinny" noise is heard, the name plate is not fastened securely and should be tightened by hammering down the holding tabs. Do the same with the serial plate on the back of the housing.

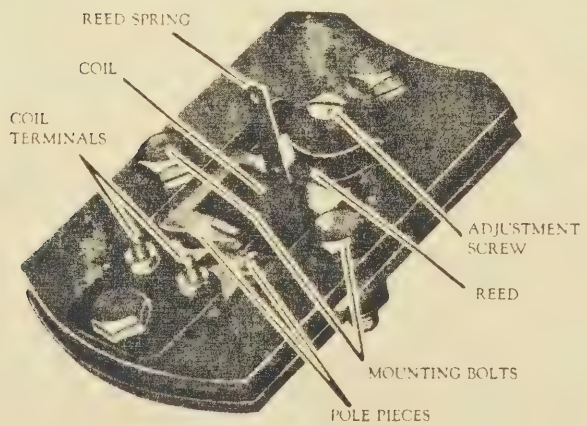


FIG. 87. CONE TYPE UNIT.

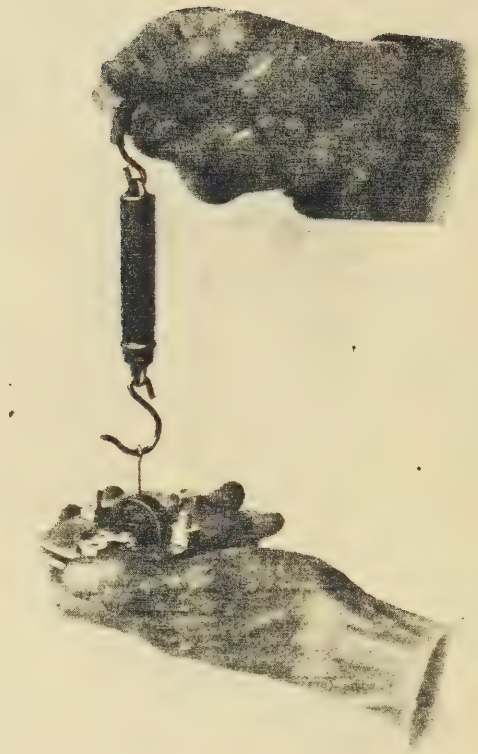


FIG. 88. TESTING MAGNET STRENGTH, CONE TYPE UNIT.

6. WEAK MAGNET—The testing outfit for determining the magnet strength is identical with that used for the horn speaker, except that instead of the flat disk a U-shaped bar is used. This bar must be accurately made so that when suspended, inverted, from the scale, its inside circumference clears the coil winding and the ends of the "U" rest flatly one on each magnet pole, lying clearly within the permanent magnet by about 1/64" on each side. It will be found more convenient to use the front or cone side of the unit for this test.

The dimensions of the bar are—width 3/8", thickness 3/32", diameter (over all) 1-3/16". If a straight pull of less than about 7 pounds will separate armature from magnet, a weak magnet is indicated and the unit should then be replaced. Fig. 88 illustrates the correct method of testing the magnet.

C. Assembling Cone Type Speaker.

1. ATTACHING SOUND UNIT—place the sound unit in the housing so that the mounting bolts pass through the holes in the back of the speaker, and screw on the acorn nuts. The unit should be enclosed in its dust-proof bag and the cord leads should be firmly attached to the coil terminals. The cord should be carried over the top of the unit, around the right-hand side and down to the outlet hole in the rear of the housing.

2. RUBBER DAMPER—push the small piece of rubber tubing on the flat reed spring, bringing it close to, but not touching, the unit.

3. MOUNTING CONE—push the metal bracket at the apex of the cone on to the flat reed spring and push the small screw thru holes. Screw on the nut but do not make it very tight.

With the two special wrenches (part No. 9255) on this small nut and bolt, tip the cone up or down so that its top and bottom edges are equally spaced from the housing, then carefully tighten the bolt. If the cone moves out of position, the bolt must be loosened and the cone again adjusted until the top and bottom edges are equally spaced from the housing when the bolt is fastened tightly.

Then examine the right- and left-hand edges of the cone to see if they are equally spaced from the housing. If they are not, use a pair of pliers to bend the reed spring very carefully and easily toward the side of the cone that is too close to the housing. When the spring is released it will be found that that edge of the cone is now spaced farther from the housing. Repeat this process until the right- and left-hand edges of the cone are equally spaced from the housing. The spacing between the edge of the cone and the housing should then be even all the way around. (In bending the reed spring, hold the pliers horizontally and grip the end of the metal bracket which fits over the reed spring. The best tool for this purpose is a parallel-jaw pliers, 3/8 inch wide, with the ends slotted to fit over the bolt and nut. The slot should be about 7/32 inch wide and 1/4 inch deep.)

4. REPLACING GRILL—Rest the speaker on its back and press the grill on to the housing, taking care to see that the screw holes coincide and that the grill is placed with the name plate right side up. It may be necessary to use a hammer in fitting the grill on the housing and, in this case, as before, a thick cloth should be used to protect the finish of the grill from the hammer blows. When the grill is in place, replace the four screws which hold it to frame.

3. Model E-3 Held-Edge Cone

The manner of disassembling, repairing and assembling the E-3 is exactly the same as for the E and E-2.

The cone of the Model E-3 speaker has a flexible rubberized fringe extending beyond the edge of the cone. Before the grill is placed on the housing, the cone and fringe are clear of the housing, with equal spacing all around between the rubber fringe and the housing. The grill has a strip of felt around its inside edge, and when the grill is pressed down on the housing, the outer edge of the rubber fringe is pressed tightly between the edge of the housing and the felt strip in the grill.

The small rubber damper is not used on the Model E-3 speaker.

Speaker in Model 52 Set

The speaker in Model 52 receiving set is of the "held-edge" type, somewhat like Model E-3. The flexible edge of the diaphragm is pressed all around between the housing flange and a large fibre ring.

To remove speaker, release cord tips from speaker posts on set, rest cabinet on its back, take out the six screws holding the speaker and draw out the speaker, fibre washer and grill.

An inspection of the speaker will then show that the diaphragm is mounted on the reed spring in the same way as in Models E, E-2 and E-3, with the exception that the edge of the diaphragm touches the metal flange all around.

Instructions for disassembling, testing, repairing, and re-assembling this speaker are similar to those given previously for the E, E-2 and E-3, with the following explanatory remarks:

(1) The small rubber reed-spring damper is not used on this model.

(2) In mounting the diaphragm, make certain that the edge of the cone (where it is joined to the flexible fringe) is level all around. If the diaphragm is not mounted properly on the reed spring, or if the spring is bent, the edge of the cone will extend up on one side and be depressed on the other. The remedy is the same as given above under the heading "Mounting Cone."

(3) The speaker is mounted in the cabinet with the outlet hole for speaker cord nearest the top, or set. The speaker cord is brought down and under the sound unit and up to the outlet hole.

(4) When replacing the speaker, put the fibre ring on top of the diaphragm, lining up the holes in the ring and those in the diaphragm and housing flange. Then place the wire grill on top of the fibre ring in such a way that, when mounted upright in normal position in cabinet, one set of equally-spaced grill wires will be horizontal and another set of equally-spaced wires will be vertical. (See paragraph immediately above.) Rest the cabinet of set on its back, and (for convenience of mounting) temporarily place a screw through the left hand hole in the housing flange, fibre ring and grill, with the head of screw toward the back of housing. Arrange the speaker in cabinet so this screw comes up through the left hand hole in front of cabinet and place a nut on this screw, meanwhile holding the speaker in place with one hand. Put in the other five screws (with the heads on outside of cabinet), remove the first screw and replace it properly.

Section XI

MISCELLANEOUS SERVICE INFORMATION

1. Use of Power Tubes in Battery Type Sets

The following battery sets were designed to permit the use of a power tube without change:

Model 20 Compact, No. 7960 (Serial Nos. 400,001 up).

Model 30 No. 8000 (later type).

Model 35.

Model 32.

Model 33.

Model 48.

Model 49.

Model 50.

Instructions are given below for changing the various earlier models of battery type sets so that a power tube can be used in the last audio socket:

Model 20 Compact, No. 7570 (Serial Nos. 200,000 to 395,766).

Model 30, No. 8000 (early type)

Remove chassis from cabinet and invert, exposing wiring under audio (3 tube) unit. Locate grid return wire leading from second audio transformer to blue wire of cable, and unsolder it from blue wire. Attach an additional short length (6 or 8 inches) of insulated wire to this lead from transformer, and bring this wire out through back of cabinet. This is the connection for the negative of "C" battery used for power tube. Connect positive of "C" battery to negative "A" battery terminal. Lastly, connect positive (black and red) terminal of speaker direct to highest voltage positive terminal of "B" batteries or "B" power unit, instead of to usual speaker post on set.

Note—If a 4½ volt "C" battery has been used already, it can be left connected, and it will then supply "C" voltage to the first audio tube only.

Model 20, No. 4640 (large cabinet), Model 19 and Model 24

Remove set from cabinet and invert. Locate grid return (red wire) which runs from second audio transformer to black wire leading from rheostat to post "Minus A." Unsolder this one red wire (there are two) from black lead, solder an 8-inch length of insulated wire to end of red wire, and bring this lead out for connection to negative of "C" battery. Connect positive of "C" battery to "Minus A" post of set. Apply 135 volts or required "B" voltage to power tube, by connecting positive speaker terminal direct to high voltage terminal of "B" batteries or other "B" voltage supply.

Open Type Sets (Mounted on Board)

Release cover from 3-tube unit and locate secondary wire from second (right-hand) audio transformer. This wire emerges from sealing compound in base of unit and is soldered to bolt head of post "Minus A." Remove this wire from this bolt, solder a separate length of insulated wire to it, and bring this lead out through ventilating hole in cover, to be connected to negative of "C" battery required by power tube. Connect positive of "C" battery to "Minus A" post of 3-tube unit.

Connect high voltage terminal of "B" batteries or "B" Power Unit, as described above for cabinet sets, direct to positive speaker cord terminal. Power tube is placed in last audio socket (right hand of two front tubes in 3-tube unit).

Note—Where dry batteries are used for "B" power, we suggest the "112A" type of power tube, 135 volts total "B" and about 9 volts "C" battery. Where storage "B" batteries or a good "B" power unit, such as the Atwater Kent Model "R," is used, we suggest using the "171A" type power tube. This tube gives perhaps a little better quality than the "112A" type, but consumes too much current to be economical when dry "B" batteries are used.

2. Replacement of Rheostat (Battery Type Sets)

(a) Removing Rheostat Assembly

(1) MODELS 20 AND 20 COMPACT. First unsolder wires leading from sub-panel to the Detector 2-stage amplifier assembly and the double rheostat. Remove the four screws which pass through the audio transformer bases which hold detector and audio panel to main sub-panel. This will release the assembly, making accessible the three screws which hold rheostat and switch panel assembly. Remove these three screws and rheostat can then be removed from main panel.

(b) Installing New Resistance

Pull out rheostat knob holding spring, releasing knob. Unsolder resistance wire terminal where it comes through panel, and pry out resistance unit. Insert new resistance unit, forcing down equally all around with suitable tool, pushing terminals through small holes in panel. Solder the one terminal, and bend the other over where it projects through panel a fraction of an inch. Replace rheostat knob, then knob holding spring and reassemble, reversing above procedure.

(2) MODELS 30 (early type) and 32. First unsolder the four wires leading to rheostat panel, remove station dial and vernier knob, take out the three screws underneath dial, which hold condenser assembly, then remove four screws (five on Model 32) on bottom of sub-panel. Next, pull condenser sub-panel assembly out from main panel, exposing three screws holding rheostat assembly

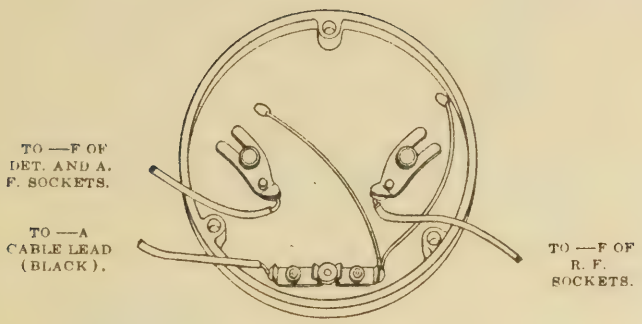


FIG. 89. REAR VIEW OF DOUBLE RHEOSTAT AND FILAMENT SWITCH ASSEMBLY USED IN MODELS 20 (No. 4640-7570), 19 AND 21.

to main panel. Pull rheostat off panel and repair as described under (1B). Reassemble set by reversing above procedure.

(3) Model 35. Remove tuning dial and lift set from cabinet. Then unsolder the three wires leading to rheostat and remove the two screws which hold it to panel. Rheostat can then be removed and repaired as necessary. (See paragraph 1B.)

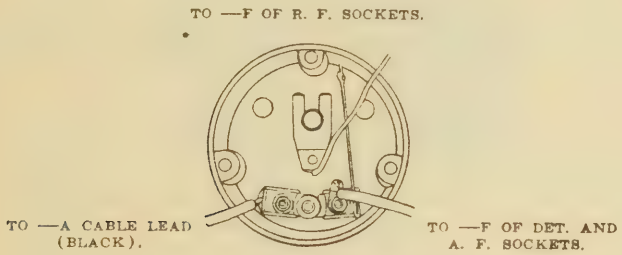


FIG. 90. REAR VIEW OF RHEOSTAT AND FILAMENT SWITCH ASSEMBLY USED IN MODEL 35.

(4) Models 30, 33, 48 and 49. Unsolder the four wires leading from rheostat panel to detector and audio assembly (where they are attached to latter). Remove station dial, vernier knob (also antenna adjustment knob on No. 33). Next remove the machine screws which hold condenser panel assembly to main panel (three at each end on Model 30, also one in center Model 33). Pull away sub-panel, exposing screws holding rheostat panel assembly, and then proceed as described under (1B).

(5) Model 50. Remove set from wood cabinet and metal case. (See Section VI.) Remove the six screws which hold front panel to condenser panel (3 at each

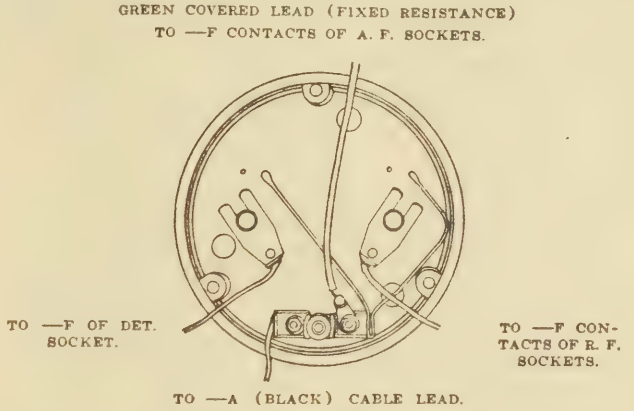


FIG. 91. REAR VIEW OF DOUBLE RHEOSTAT AND FILAMENT SWITCH ASSEMBLY USED IN MODELS 20 COMPACT (No. 7960), 30 (Early Type), 32, 33, 48, 49 AND 50.

NOTE.—The appearance of the rheostat in later Model 30 sets, and in Models 48 and 50, is slightly different from that shown above, but the connections are similar.

side). Let front panel drop forward, leaving rheostat panel attached to sub-panel. Remove the two screws which hold rheostat panel to sub-panel, releasing the former, so that it can be readily approached and repaired in the same manner as the other sets. (See paragraph 1B.)

3. Synchronizing Variable Condensers in One Dial Receivers

In order for a set of the single-dial type to be at maximum efficiency it is extremely important that all the variable condensers be "synchronized," that is, so adjusted on their shafts that they will all tune in a desired wave length with equal efficiency at any point on the wave band.

It is understood, of course, that all the R. F. transformers and condensers in any set are matched properly at the factory, and also are correctly synchronized, however, occasionally the synchronism is disturbed by a jar to the set in shipment, etc., in which case re-synchronizing is required. The apparatus required and procedure of checking is practically the same as described in Section III, under "Testing Set for Output," and is as follows:

For the purpose of checking a set which it is desired to synchronize, a pre-determined standard of volume of output should be made use of. This standard is obtained from a set known to be perfect, or better still, the average of the output of several sets of the same type, all known to be functioning properly. The volume must be checked on three wave lengths, at low, medium and high—as for example, at points 20, 40 and 80 on the dial. The procedure is as follows:

1—Place the signal-producing apparatus at such distance from the receiving test stand that when it is in operation with the dial set at 50, the output reading on the galvanometer of the test stand when connected to the standard set will be around 50 or 60. A little experimenting will be necessary to do this, but by regulating the position of the antenna wire from the transmitter, a satisfactory adjustment can be arrived at.

2—Turn on transmitter, loosen the set screws in condenser pulleys of the set being tested, and turn switch on test stand, so that the set being tested will register on the galvanometer. (Do not loosen screws in dial-condenser pulley.)

3—Set condenser dial of transmitter at 80 (high) and then turn the condenser rotor assemblies in the set by hand, until the signal is tuned in on the test stand, as shown by a maximum output reading on the galvanometer. Make a notation of the reading on paper. Great care should be taken that the position of antenna wire from transmitter is not changed during the following process, the setting of the tuning dial only being carefully changed when passing from one wave length to another.

4—Next set transmitter dial at 40 (medium) and readjust condensers in set for maximum galvanometer reading, again making a pencil notation of the reading.

5—Repeat this with the dial at 20 (low), again jotting down the reading obtained.

6—With condensers set for maximum volume at low, tighten set screws in pulleys very carefully so as not to disturb adjustment. The reading after they are tightened should be the same as when they were loose.

7—Now readjust transmitter to medium and high successively and note how the reading compares with the one obtained previously, when the belts were loose. If there is more than 25 or 30% lower output on either medium or high, it indicates that the radio frequency units are not matched and the set will not be up to standard on that particular band of waves, especially on distant reception. In such cases the trouble will most likely be found in either the R. F. transformer assembly or the variable condenser group. If a thorough visual inspection of the R. F. transformers does not reveal any defect, the condensers may be "out" and had best be replaced, as per instructions in Section VI.

8—The standard set should be connected to the test stand while the test is being made, so that by simply switching over to the standard set, the reading of the galvanometer on each wave length can be compared with the standard immediately. The standard set is used as a means of checking and keeping constant the output from the transmitter.

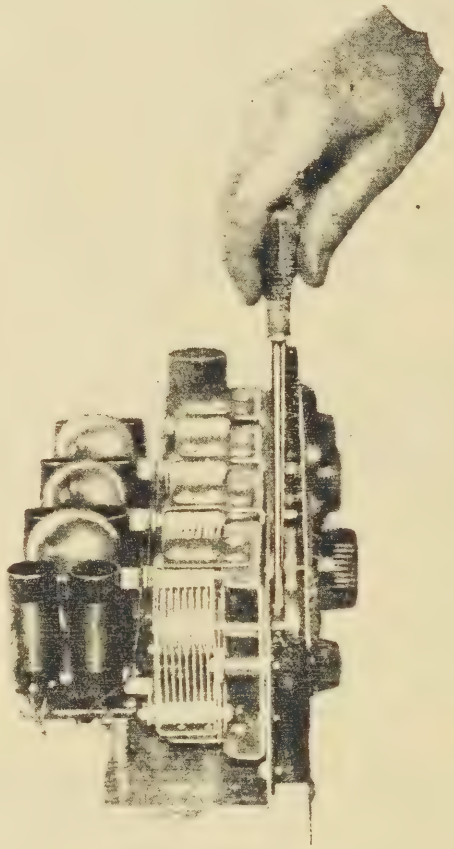


Fig. 92. Tightening Pulley Set Screws After Condensers Have Been Synchronized at a Low Wave Length.

4. Adjusting Tension of Belts in Single Dial Atwater Kent Receivers

On Atwater Kent single dial receiving sets the variable condenser to which the dial is attached (termed the "dial-condenser") is held in a fixed position by three screws.

Each of the other variable condensers is arranged in such a way that when its three screws are loosened, it may be moved independently a fraction of an inch toward or away from the dial-condenser, thus loosening or tightening one belt. When the condenser has been moved to the point giving the correct belt tension the three screws holding the condenser are carefully tightened.

At the factory the belt tension is determined by the use of an auxiliary gauge which gives an accurate indication of tension. These gauges are not available outside, so dealers' and distributors' service men must judge the tension by the "feel" of the belt when it is pressed down lightly with the forefinger. The belt must be tight enough to avoid "play" in the movement of the condenser, but the tension must not be great enough to bind the rotary plates.

The service man should carefully estimate the tension of belts on sets that have been adjusted at the factory, and then endeavor to secure the same tension on all belts that he may adjust.

In the case of sets in which the pulleys and belts are already properly arranged, the belt tension should be adjusted in accordance with the instructions given under the heading, "**Adjusting Belt Tension.**" If the pulleys and belts have been removed from the set, as is neces-

sary when replacing the condenser assembly, they should be replaced as described under the separate headings "**Pulleys**" and "**Belts.**"

PULLEYS

Put dial-condenser pulley on the shaft of dial-condenser, with hollow side of the pulley facing set. This pulley has two short "pins" on its outside surface. Turn pulley so the **outer** one of the two pins is exactly on top. Hold pulley in this position and move rotary plates of the dial-condenser all the way inside the stationary plates. Then, with the pulley and condenser in this position, carefully tighten the two set-screws in the pulley. Make sure these screws are tight. The pulley should not be pushed in too far on the condenser shaft or the belt will rub against the set.

The illustrations (Figures 93, 94 and 95) show clearly how the other pulleys should be arranged on the condenser shafts.

The pulleys on the shafts of all variable condensers (except the dial-condenser pulley) must turn freely or difficulty will be experienced in synchronizing the condensers. Twirl each pulley to see if it moves freely. If it does not move easily, rub the condenser shaft and pulley-bearing free from dirt and try again. If the pulley sticks, replace it or smooth off the condenser shaft with a fine grade of emery cloth. Also remove any burrs from the ends of the pulley bearing.

Do not proceed further until the pulleys turn easily. If the difficulty is caused by a damaged condenser shaft, replace the group of condensers.

BELTS

(a) Each belt must be arranged with the eyelets (that clamp the two ends of the belt together) at the bottom of the belt loop. Each belt has two small holes, one to fit over one of the pins on the dial-condenser pulley and the other hole to fit over the pin on the pulley which that belt controls.

Loosen screws in the outer condensers and move them toward the dial-condenser so the belts will fit easily over the pulleys. In moving condensers, hold them by the heavy frame of the stator plates. Never place any strain on the pulley, shaft, or rotary plates of the condenser. .

(b) Models 30, 35, 37, 40, 41, 42, 48 and 50, Arranging Belts

First put on the belt that fits over the **inner** one of the two pins on the dial-condenser pulley and over the pulley of the third (right) condenser.

Then put on the belt that fits over the **outer** one of the two pins on the dial-condenser pulley and over the pulley of the first (left) condenser.

(c) Models 32, 33, 36 and 49, Arranging Belts

First put on the belt that fits over the **inner** one of the two pins on the dial-condenser pulley and over the third pulley.

Then put on the belt that fits over the **inner** one of the two pins on the dial-condenser pulley (it will be on top of the first belt) and over the pulley of the fourth (right) condenser.

Finally put on the belt that fits over the **outer** one of the two pins on the dial condenser pulley and over the pulley of the first (left) condenser.

(d) Models 38 and 44, Arranging Belts

First put on the belt that fits over the first (dial condenser) and second pulleys, then the belt that fits over the first and third pulleys, and finally the belt that fits over the first and fourth pulleys. All three belts fit over the **inner** one of the two pins on the dial-condenser pulley.

ADJUSTING BELT TENSION

Preliminary Procedure

(a) See that the three screws holding dial-condenser to chassis are tight, and that the three screws in each of the other variable condensers are slightly loosened. Note that the holes through which these latter screws pass are slotted, allowing the condenser to be moved horizontally a fraction of an inch toward or away from the dial-condenser. Two pins projecting from the front of the condenser fit into two horizontal slots and serve to keep the condenser properly aligned. Be certain that the condenser pins are in the slots and not jammed outside. (Models 30 (early type) and 32 have moulded end-plate variable condensers and these do not have the projecting pins.)

(b) In Atwater Kent single-dial receivers having metal frame variable condensers, a hole is provided in the front of the chassis at the edge of each condenser. The hole is placed on that side of the condenser which is nearest to the dial-condenser. The frame of the condenser partly covers the hole. By inserting the blade of a screw driver (held in the left hand) in this hole and twisting the blade, the condenser may be moved away from the dial-condenser, thus tightening one belt. When the condenser is moved to the point giving the correct belt tension, keep the condenser in that position and then, with another screw driver in the right hand, tighten the three screws that hold the condenser to the chassis.

In Models 30 (early type) and 32, both of which have moulded end-plate variable condensers, holes for moving the condensers are not provided in the metal bracket on which the condensers are mounted. In these sets the condensers may be moved with the fingers when adjusting the belts.

In four-condenser sets where two or three belts are placed over each other, the tension of the **under** belt must be adjusted first and the upper belts must be slack. If the upper belt is adjusted first, it will not be possible to judge the tension of the lower belt. The correct order for adjusting belts in the different sets is given below under separate headings for the various types of sets.

(c) The screws must be tightened carefully so the condenser will not move and change the belt tension. If the condenser does move, causing the belt tension to change, loosen the three screws, readjust the tension, and again tighten the screws. Repeat, if necessary, until when the screws are tight, the tension is correct. Make the screws very tight.

Models 30 (later type), 35, 37, 40, 41, 42, 48, 50 and 52, Adjusting Belt Tension

Adjust right-hand belt first. Insert the blade of a screw driver in the chassis hole at the left-hand edge of the third condenser. Twist the blade slowly, forcing the third condenser toward the right until the belt seems to have the correct tension, as judged by the finger, hold the condenser in that position and, with another screw driver, tighten the three screws. Adjust the left belt in the same general way. See paragraph (c) above.

Models 38 and 44, Adjusting Belt Tension

First adjust tension of belt that passes over pulleys of dial-condenser and second condenser. Then adjust belt passing over pulleys of dial-condenser and the third condenser, judging the tension by pressing down on this belt between the second and third pulleys. Finally adjust tension of belt passing over pulleys of dial-condenser and the right-hand condenser, judging the tension by pressing down on this belt between the third and fourth pulleys. See paragraph (c) above.

Models 32, 33, 36 and 49, Adjusting Belt Tension

First adjust belt passing over pulleys of dial-condenser and third condenser. Then adjust belt passing over pulleys of dial-condenser and fourth condenser, judging tension by pressing down on this belt between the third and fourth pulleys. Finally adjust left-hand belt. See paragraph (c) above.

Part Numbers of Pulleys and Belts

(Refer to Illustrations for Identification and Arrangement of Pulleys and Belts)

MODEL OF SET	BELTS			PULLEYS			
	"A"	"B"	"C"	No. 1	No. 2	No. 3	No. 4
30 (Molded end-plate variable condensers.)	7965	7965		9168	9169	9168	
35, 37, 48 and 30 (with metal frame variable condensers).	8146 (Long)	8136 (Short)		9168	9169	9168	
32	8146	8146	8282 (Long)	9168	9169	9168	9171
38	8963 (Short)	8964 (Long)	13264 (Extra Long)	9169	9168	9171 (Identified by two holes through side).	13263 (Identified by one hole through side and letter "E" stamped inside.)
50	8146	8146		9168	9169	9168	
33, 36 and 49	8963	8963	8964 (Long)	9168	9169	9168	9171
40-42-52	13484 (Long)	13483 (Short)		9168	9169	9168	
44	13675 (Short)	13676 (Long)	13677 (Extra Long)	9169	9168	9171	13263

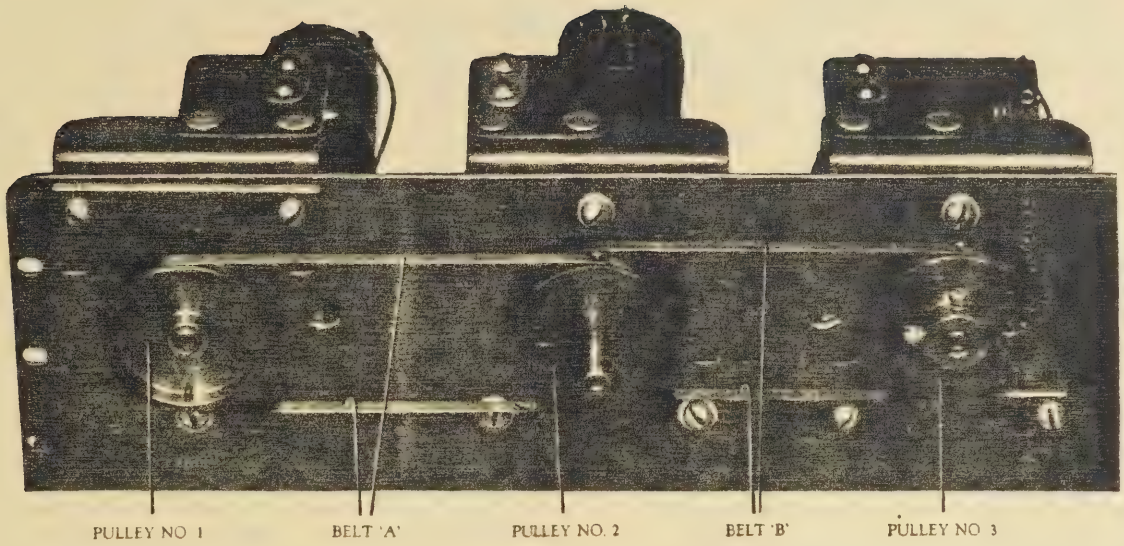


FIG. 93. VIEW OF 37 CHASSIS, SHOWING HOW PULLEYS AND BELTS ARE MOUNTED. The same arrangement is used in Models 30, 35, 40, 41, 42, 48, 50 and 52.

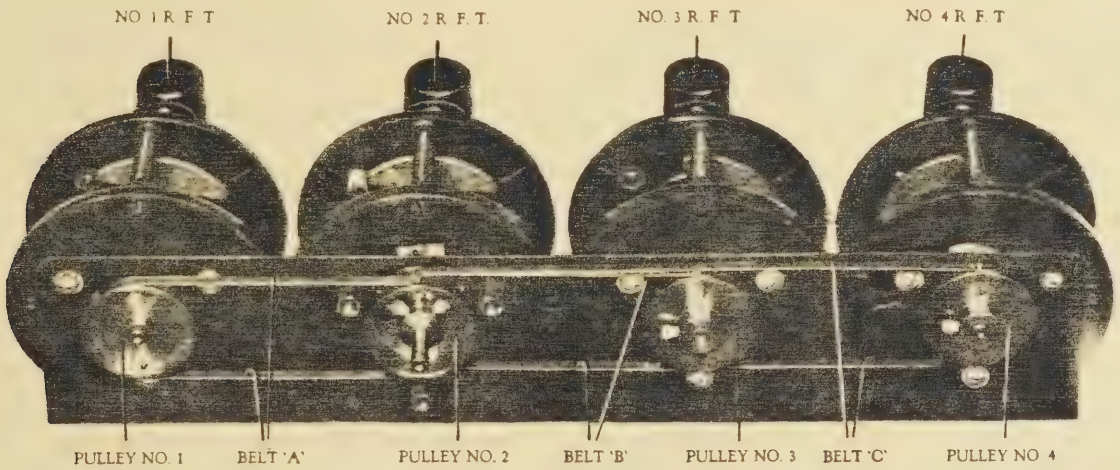


FIG. 94. FRONT VIEW OF MODEL 32 SUB-PANEL ASSEMBLY. The same arrangement of pulleys and belts is used on Models 33, 36 and 49, except that the dial-condenser pulley is usually placed with the hollow side toward the condenser.

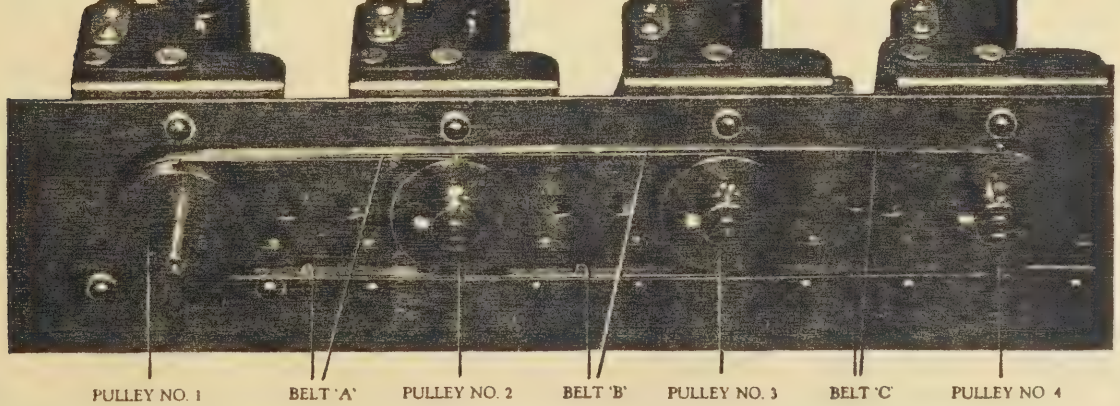


FIG. 95. FRONT VIEW OF MODEL 38 CHASSIS. The pulleys and belts on Model 44 are arranged in a similar manner.

SECTION XII
Model 41 Direct Current Receiver

General Description

The Model 41 is a seven tube receiver similar in appearance to Model 40, but designed to operate on 110 volts **Direct Current** (D. C.). The power unit and filament circuits are therefore quite different from those in the A. C. sets, and owing to the low maximum voltage available for plate supply, the audio frequency circuit is arranged differently from that in the battery type and A. C. electric sets.

Since the power supply for this set is direct current, and D. C. type tubes are used throughout, the function of the power unit is simply to act as a filter to smooth out the current as received from the original source, and reduce and distribute it as necessary for the plate and filament supply of the tubes.

As will be noted from the simplified diagram (Fig. 96), the power unit consists of the following parts:

(a) 2 R. F. Chokes, one in each side of line.
(b) 2 A. F. Filter Chokes connected in series in positive side of line.
(c) 3 Fixed Condensers connected across line at points between the series of choke coils.
(d) A Series Resistor, mounted on outside of power unit at one end, and connected in series with one side of the D. C. line. The purpose of this resistor is to reduce the line voltage to a value such that, when all the tube filaments are connected in series across the line, each will receive approximately its rated voltage.
(e) Output choke, through which the filtered positive voltage is applied to the plates of the two last audio tubes.
(f) Detector plate voltage resistor. This is mounted along with the R. F. chokes (a) on the lower side of the power unit panel assembly.

It will be noted that the audio amplifier tubes receive practically the full line voltage as their plate supply, except that there is a slight drop in voltage in passing through the filter system.

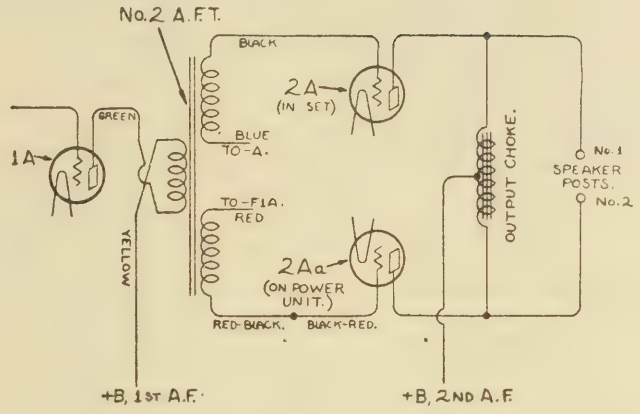


FIG. 97. SCHEMATIC DIAGRAM OF THE "DOUBLE AUDIO" 2ND A. F. STAGE IN MODEL 41.

The series resistor reduces the 110-volt supply to 35 volts, and this 35 volts is applied to the terminals of the filament circuit of the set, which includes the filaments of all the seven tubes in series. Since in accordance with a fundamental law of electricity this voltage is divided among the filaments, each receives approximately 5 volts. To further equalize the voltage on the tubes, shunt resistors are connected across some of the tube filaments. Without these resistors, the tubes at the negative end of the series would receive the highest voltage, due to the cumulative addition of the plate currents.

The audio amplifier system used on the Model 41 is somewhat different from that used on previous models. The first stage of audio is the same, but the second stage consists of two of the 171-A type tubes arranged with a double secondary audio transformer, as shown in the diagram, Fig. 97. The additional tube socket required is mounted on the outside of the right hand end of the power unit.

(Continued on page 94.)

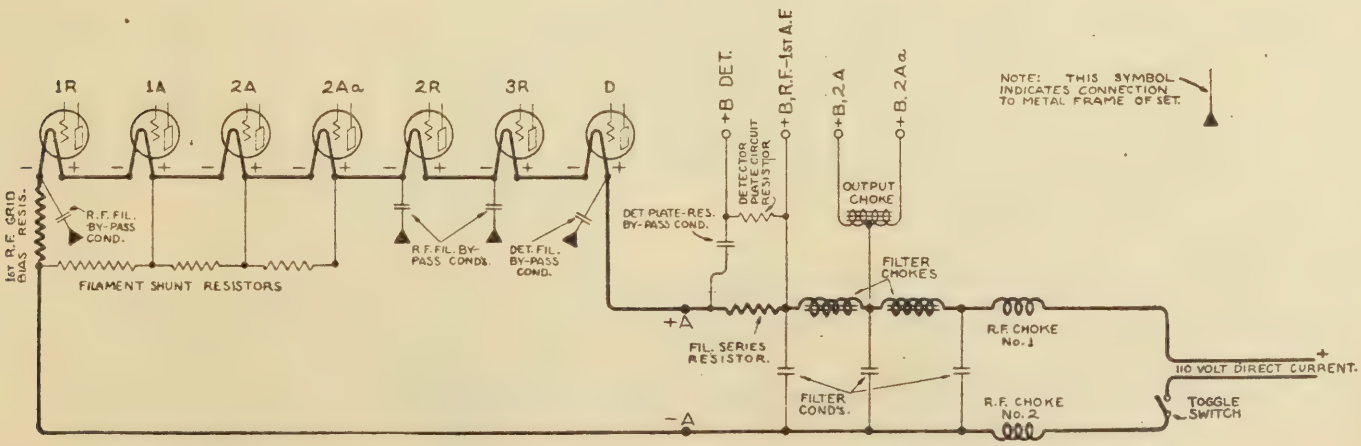


FIG. 96. SIMPLIFIED DIAGRAM OF POWER UNIT AND FILAMENT CIRCUIT IN MODEL 41 RECEIVER.
Tubes of the 112-A type are used in all sockets except 2A and 2Aa.

Continuity Test Table and Chart—Model 41 D. C. Set

(For Following Tests, Remove Cable Panel from Power Unit. Colors Refer to Cable Leads)

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
Each cable lead end to corresponding soldered cable connection under set (except yellow, and black-red tracer).	*Full*	Open in cable or connection.	**Examine cable for broken leads and short circuits. Repair or replace cable if necessary.**
GROUND POST to Metal Chassis.	*Full*	Open connection.	Examine lead from volume control to metal chassis.
Black.	*None*	Shorted R.F. by-pass condenser, grounded fil. circuit, or grounded A.F. grid. circuit.	**NOTE.—If a by-pass condenser is thought to be defective, unsolder its lead from rest of circuit and test condenser separately.**
White.	*None*	Shorted R.F. by-pass condenser, or grounded R.F.-1st A.F. plate circuit.	
Black-Red Tracer.	*None*	Grounded secondary No. 2 A.F.T.	
Yellow.	*None*	Grounded detector plate circuit.	
+FD	*None*	Shorted detector filament condenser.	
—F3R	*None*	Shorted R.F. by-pass condenser.	
Stator Each Var. Cond.	*None*	Shorted variable condenser.	Or grounded R. F. grid.-fil. circuit.
Top Cont. of Vol. Cont.	*Nearly Full*	Open resistance unit in volume control.	
Antenna Terminal. (Turn Volume Knob.)	*Smooth and Nearly Full*	No reading—open res. winding. Erratic reading—damaged winding or slider.	
Center (Tap) Contact On Ant. Coup. Trans.	*None*	Shorted volume control condenser.	
BLACK to Red-White Tracer.	*Nearly Full*	Open filament shunt resistor.	
—F1R	*Full*	Open 1st R.F. grid bias resistor.	Green (or black) covered wire.
+F1A	*Nearly Full*	Open between +F1A and contact No. 2.	
—F2A	*Nearly Full*	Open connection between +F1A and —F2A.	
+F2A	*Nearly Full*	Open between +F2A and contact No. 3.	
—F2R	*Nearly Full*	Open between —F2R and contact No. 4.	
G1R	*Nearly Full*	Open antenna coupling transformer.	
G2R	*Partial*	None—Open secondary No. 1 R.F.T. or open No. 1 grid resistor.	Full-Shorted grid circuit or resistor.
G1A, G2A	*Partial*	None—Open secondary No. 1, 2 A.F.T.	Full—Shorted secondary.
YELLOW to PD	*Partial*	None—Open primary No. 1 A.F.T.	Full—Shorted primary.
YELLOW to —FD	*None*	Shorted phone condenser.	
WHITE to P1R	*Partial*	Open primary No. 1 R.F.T.	Or open 1st R.F. plate resistor.
P2R, P3R	*Full*	Open primary No. 2, 3 R.F.T.	
P1A	*Partial*	None—Open primary No. 2 A.F.T.	Full shorted primary.
OTHER TESTS			
+F1R to —F1A	*Full*	Open connection.	
+F2R to —F3R	*Full*	Open connection.	
+F3R to —FD	*Full*	Open connection.	
G3R to —F3R	*Partial*	None—Open secondary No. 2 R.F.T. or open No. 2 grid resistor.	Full—Shorted grid circuit.
Stator of Det. Var. Cond. to GD	*None*	Shorted grid condenser.	
Stator of Det. Var. Cond. +FD	*Full*	Open secondary No. 3 R.F.T.	

NOTE.—The readings vary somewhat, depending on the resistance of the meter.

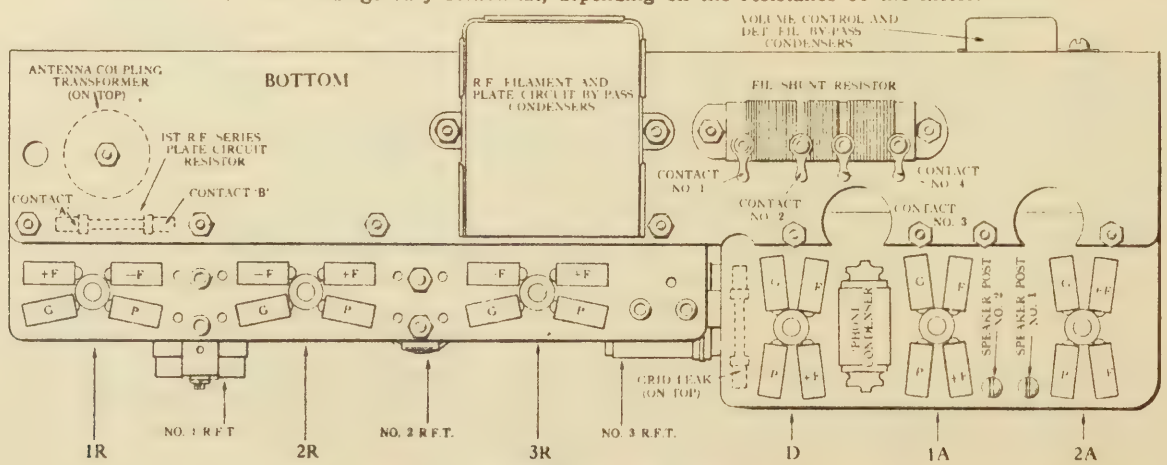


FIG. 99. TESTING CHART FOR MODEL 41.

(Note that the filament contacts of sockets 1-R and 2-A are reversed from the usual polarity.)

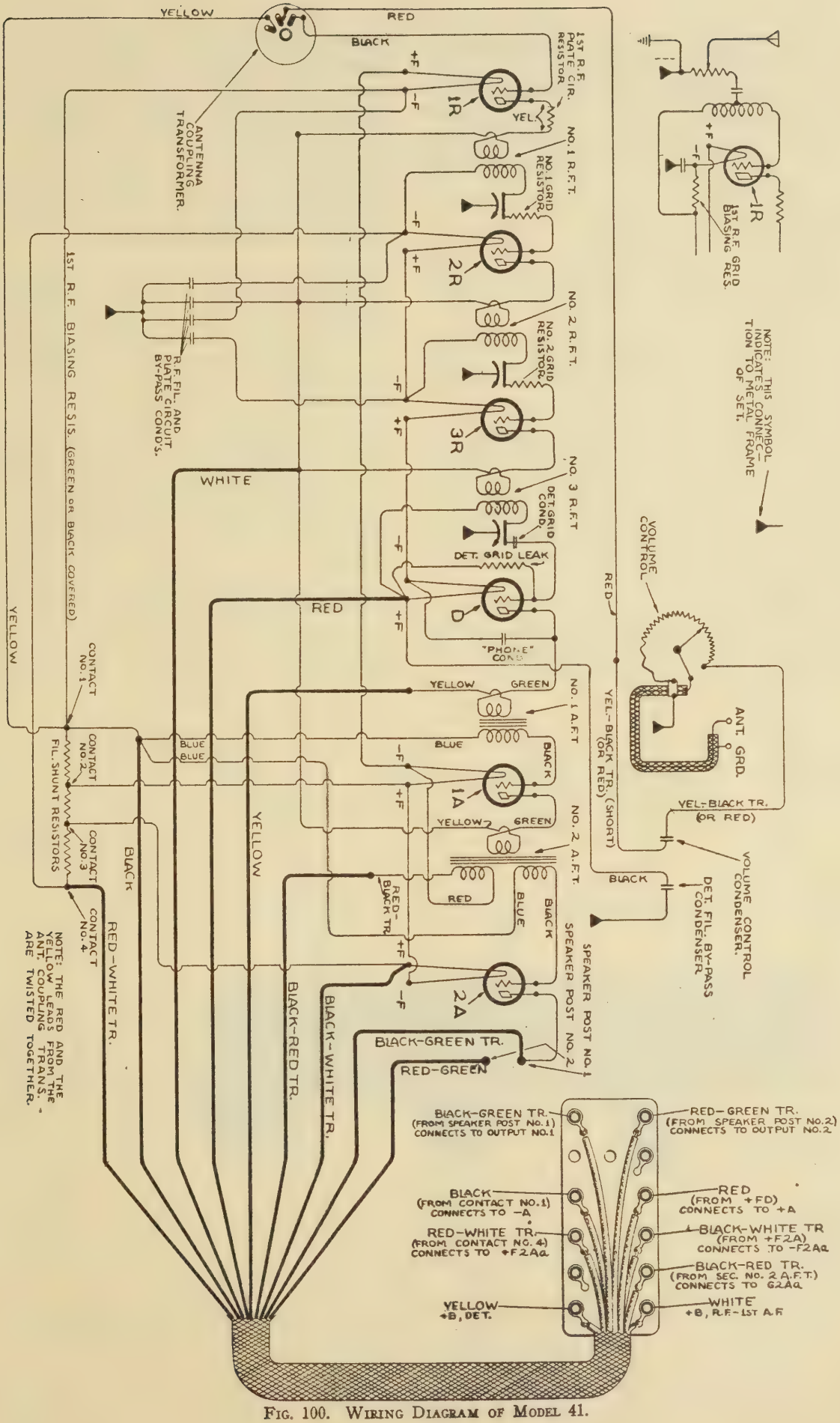


FIG. 100. WIRING DIAGRAM OF MODEL 41.

Due to the comparatively low plate voltage available (approximately 90 volts after filtering) two stages of straight audio amplification connected in standard fashion, would not provide sufficient undistorted output volume. The use of two tubes in this 2nd A. F. "double audio" arrangement causes the available undistorted volume to be equal to that of the A. C. sets, although the plate voltage is much lower.

Special Notes on Installation

The service man should be familiar with several special points which must be observed in connection with the satisfactory installation of Model 41.

REVERSING PLUG: If the set does not operate when first installed (although the tubes light), reverse the two-pronged plug into the electric socket, so that the current flows in the proper direction.

USING COUNTERPOISE: In some cases where an unpleasant hum is experienced in reception, this can be overcome by the use of a "counterpoise" instead of a ground connection. A counterpoise consists of a length of insulated wire connected to the ground post of the set, the other end being open. This wire can be strung in any convenient manner, preferably in a straight line, or nearly so.

DETECTOR CAP: The metal cap furnished with the set (in small envelope) should be placed over the detector tube, which is fourth from left. This will prevent microphonic noises, such as a howl or hum.

Removing Chassis from Cabinet Replacing Variable Condensers

Instructions for removing the chassis from cabinet and for replacing the group of variable condensers are the same as given on page 63 for Model 42.

Replacing R. F. Amplifier Assembly

If one R. F. transformer is defective, replace the R. F. amplifier assembly, an illustration of which is shown in Fig. 98.

Procedure: Remove chassis from cabinet. Unsolder four leads from by-pass condensers, and filament leads at filament contacts —F1A and —FD. Unsolder lead from the secondary of No. 3 R. F. T. at filament contact +FD. Loosen lower nut on rear of each variable condenser and remove the secondary lead lugs. Unsolder green (or black) insulated resistance wire from —F1R and unsolder blue lead from —F2R. Unsolder white cable lead and yellow lead of No. 2 A. F. T. from the exposed section of the +B, R. F lead at the right hand end of the R. F. assembly. Unsolder leads to contacts "A" and "B" on R. F. plate circuit resistor. Unsolder black lead from antenna coupling transformer at G1R and unsolder leads from grid resistors at contacts G2R and G3R.

Unscrew four bolts holding the assembly and the 1st R. F. series plate resistor strip, then remove the assembly.

Reassemble with replacement R. F. amplifier, reversing above procedure. Replace the 1st R. F. resistor mounting strip.

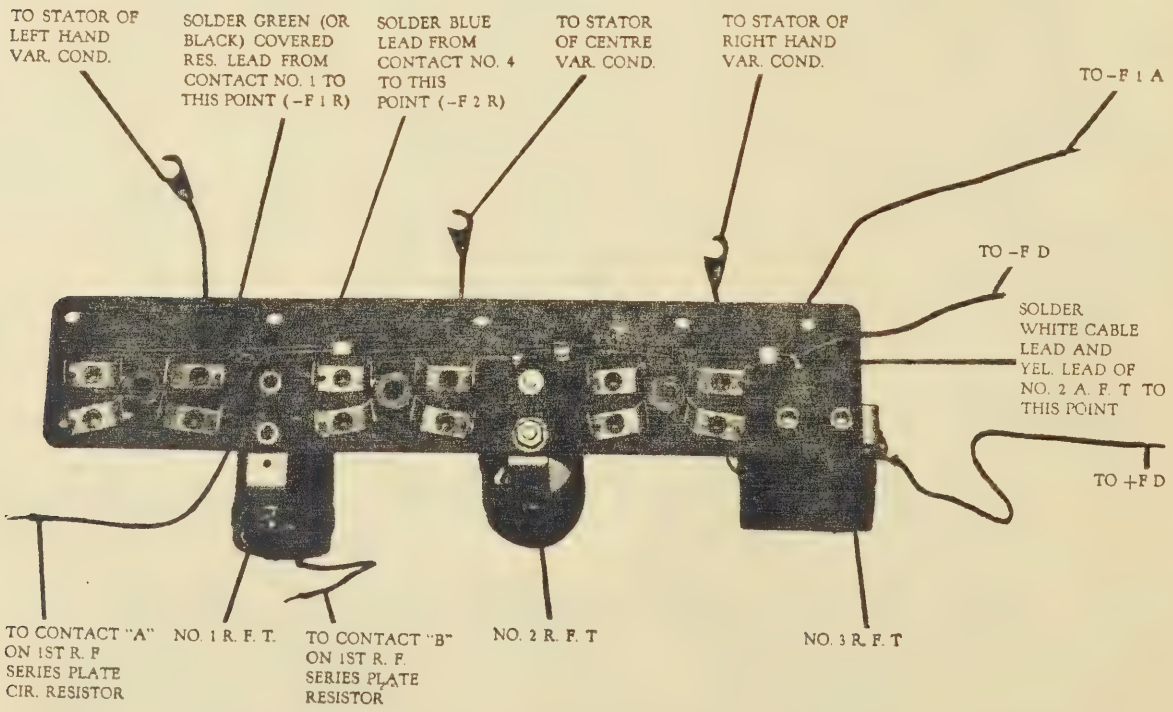


Fig. 98. View of R. F. Amplifier Assembly, Showing Where Each Lead is to be Connected.

Voltage Test Table

ATWATER KENT DIRECT CURRENT RECEIVERS

All Measurements Made While Set Is in Operation
Use high-resistance D. C. Voltmeter‡

Voltage at Power Unit Panel Assembly.	APPROXIMATE VOLTAGE Models 41-51
—A to +A.	35 V.
—A to +B, R.F.-1st A.F.	90 V.
—A to +B, Detector.	60 V.
—A to Output No. 1.	95 V.
—A to Output No. 2.	95 V.
Filament Voltage at Set.*	
—F1R to +F1R (1st R.F. Filament).	4.8 V.
—F2R to +F2R (2nd R.F. Filament).	4.9 V.
—F3R to +F3R (3rd R.F. Filament).	4.6 V.
—FD to +FD (Detector Filament).	4.6 V.
—F1A to +F1A (1st A.F. Filament).	4.9 V.
—F2A to +F2A (2nd A.F. Filament).	4.8 V.
Grid Bias at Set.*	
—F1R to G1R (1st R.F. Bias).	2 V.
—F1A to G1A (1st A.F. Bias).	4.8 V.
—F2A to G2A (2nd A.F. Bias).	9.7 V.
Plate Voltage at Set.*	
—F1R to P1R (1st R.F. Plate).	60 V.
—F2R to P2R (2nd R.F. Plate).	65 V.
—F3R to P3R (3rd R.F. Plate).	65 V.
—FD to PD (Detector Plate).	24 V.
—F1A to P1A (1st A.F. Plate).	81 V.
—F2A to P2A (2nd A.F. Plate).	81 V.
Voltage at 2nd A.F. Tube on Power Unit.*	
—F to +F (Filament Voltage).	4.8 V.
—F to G (Grid Bias Voltage).	9.7 V.
—F to P (Plate Voltage).	85 V.

* Contact made through socket eyelets. ‡ The readings in the table were taken with a Weston No. 489 (0—50—250) voltmeter. Other types of voltmeters may give slightly different values.

Model 51. The Model 41 receiver is also manufactured in a thirty-inch high metal cabinet like that of Model 52. This receiver is known as Model 51. The chassis is identical with Model 41, except that the shielded antenna lead is not used—instead, two twenty-foot leads are furnished for connection to the regular antenna and ground. The speaker in Model 51 is the same as in Model 52—service instructions for this type speaker are given on page 83.

Power Unit in Direct Current Receivers

General Information

A simplified circuit diagram of the power unit used in the Atwater Kent Model 41 direct current receiver is shown in Fig. 96. A wiring diagram of one of the first units of this type is shown in Fig. 103. Slight modifications were made subsequently in order to improve the reliability of the unit. The modified arrangements are shown in Figs. 101 and 105.

A socket for one of the 2nd A. F. amplifying tubes is mounted at the right hand end of the power unit. A filament series resistor (similar in appearance to the regulating resistor in A. C. power units) is mounted at the left hand end of the unit.

Instructions for removing the power unit from cabinet are similar to those given on page 69 for Model 42 unit.

Testing

Apply the continuity tests given in the table on this page. If the tests indicate that the filament series resistor, detector plate circuit resistor or one of the R. F. choke coils is defective, it may be replaced. If anything is defective in the A. F. filter chokes or condensers, which are sealed in the metal container, a new sealed container should be substituted.

Replacing Sealed Power Unit Container

Remove the lid of unit and the filament series resistor. Unsolder leads from sealed container at panel assembly. Unsolder four leads from tube socket contacts and the two primary winding leads where one connects to the toggle switch and the other connects to one side of the 110-volt supply cable.

Remove two screws holding socket to angle bracket and remove socket. Pull the power-unit cable leads up through the hole in tube socket angle-bracket and pull the red-green tracer lead and the primary winding leads up through the cable covering. Remove the panel assembly with attached power-unit cable leads. (In the early type of unit shown in Fig. 103, the primary winding leads are not brought through the power unit cable.)

Reassemble with replacement sealed container, reversing the above procedure. Note that the red-green tracer lead and the primary winding leads from the replacement sealed container should be brought through the power-unit cable. This may be accomplished with the aid of a piece of bus-bar, hooked at one end, by pushing the bus-bar up through the cable from the socket end, fastening the lead to the hook, and pulling the bus-bar back again, thus drawing the lead through the cable covering.

Note.—In servicing or assembling the direct current power unit, make certain that the R. F. choke coil contacts do not make accidental connection with any of the terminals on the panel assembly.

Continuity Test Table for Direct Current Type Power Unit

For Following Tests, Remove Cable Panel from Power Unit

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
Each Socket Contact to Corresponding Terminal on Panel.	*Full*	Open in lead or connection.	
Test Across Contacts on Each R.F. Choke.	*Full*	Open R.F. choke.	
+B R.F.-1st A.F. to			
+110 Volt Input.	*Nearly Full*	None—Open filter choke or connection.	
+B Detector.	*Partial**	None—Open detector plate circuit resistor.	Nearly Full—Shorted detector by-pass condenser.
+A	*Nearly Full*	None—Open filament series resistor.	Examine resistor carefully to see if it is open, shorted, or damaged in any way.
—A	*None*	Shorted filter condenser or shorted pos. cir.	
Output No. 1.	*Nearly Full*	None—Open output choke or connection.	
Output No. 2.	*Nearly Full*	None—Open output choke or connection.	
—A to —110 Volt Input.	*Full*	Open connection in negative line.	
Exposed Edge of Metal Container to —A, +A	*None*	Grounded circuit.	Examine power unit wiring for external grounds. If ground is internal, replace the sealed container.

* If using a low-resistance testing voltmeter, this reading will be "small."

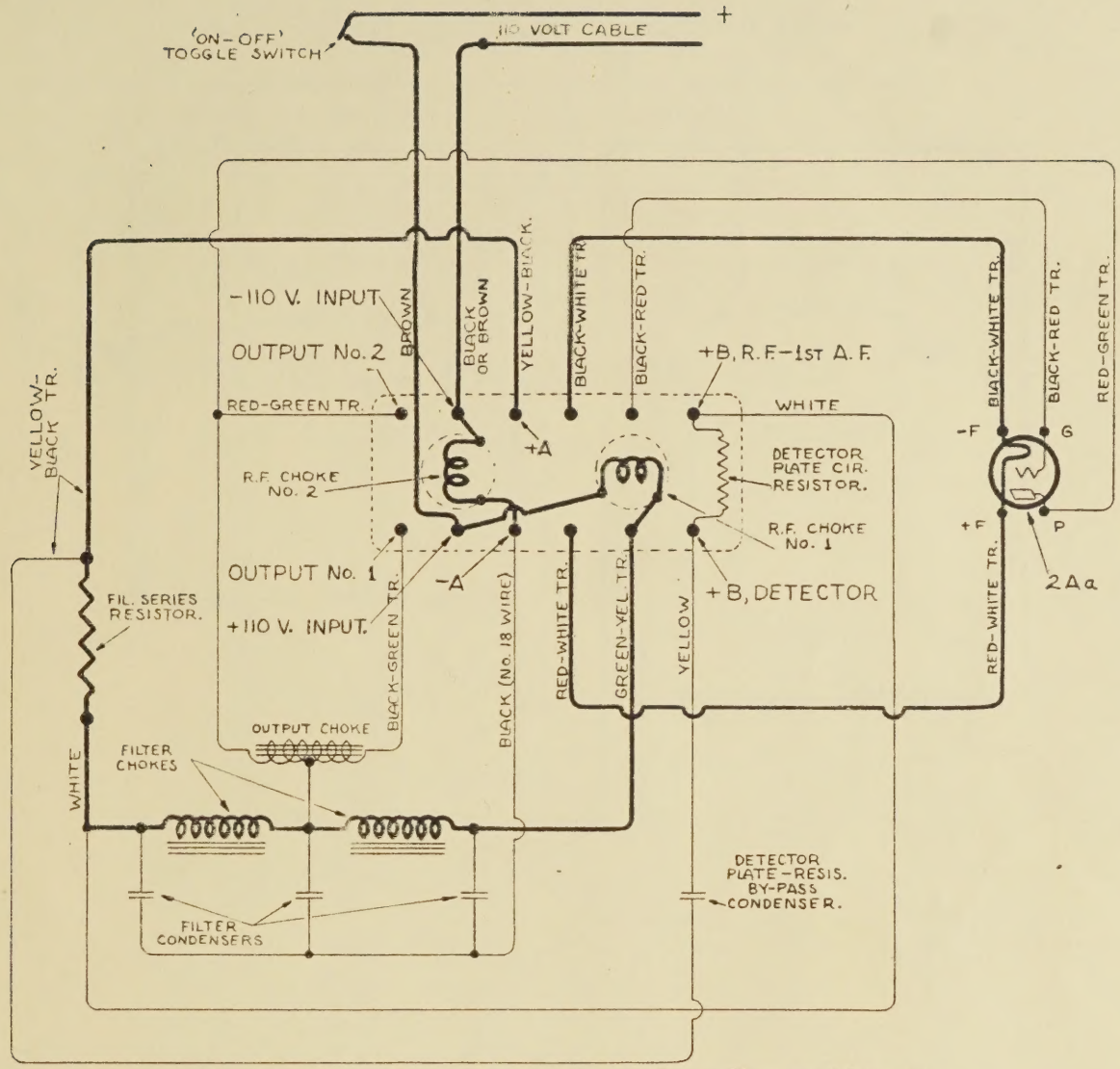


FIG. 101. WIRING DIAGRAM OF 3RD TYPE OF POWER UNIT FOR MODEL 41.

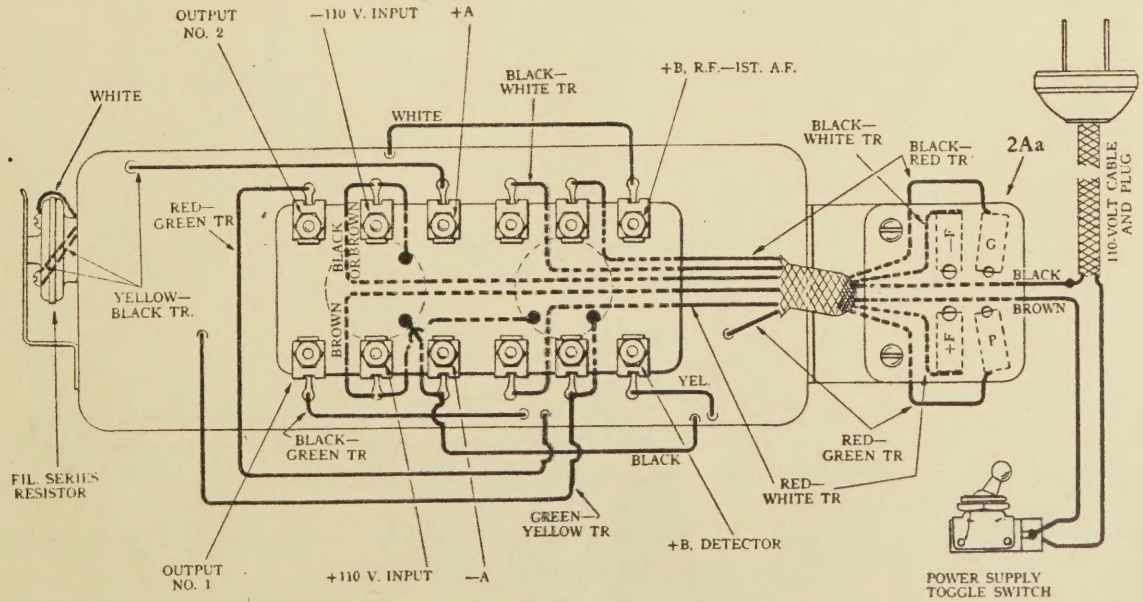


FIG. 102. SHOWING CONNECTIONS AND APPROXIMATE POSITION OF LEADS FROM SEALED CONTAINER IN 3RD TYPE OF POWER UNIT.

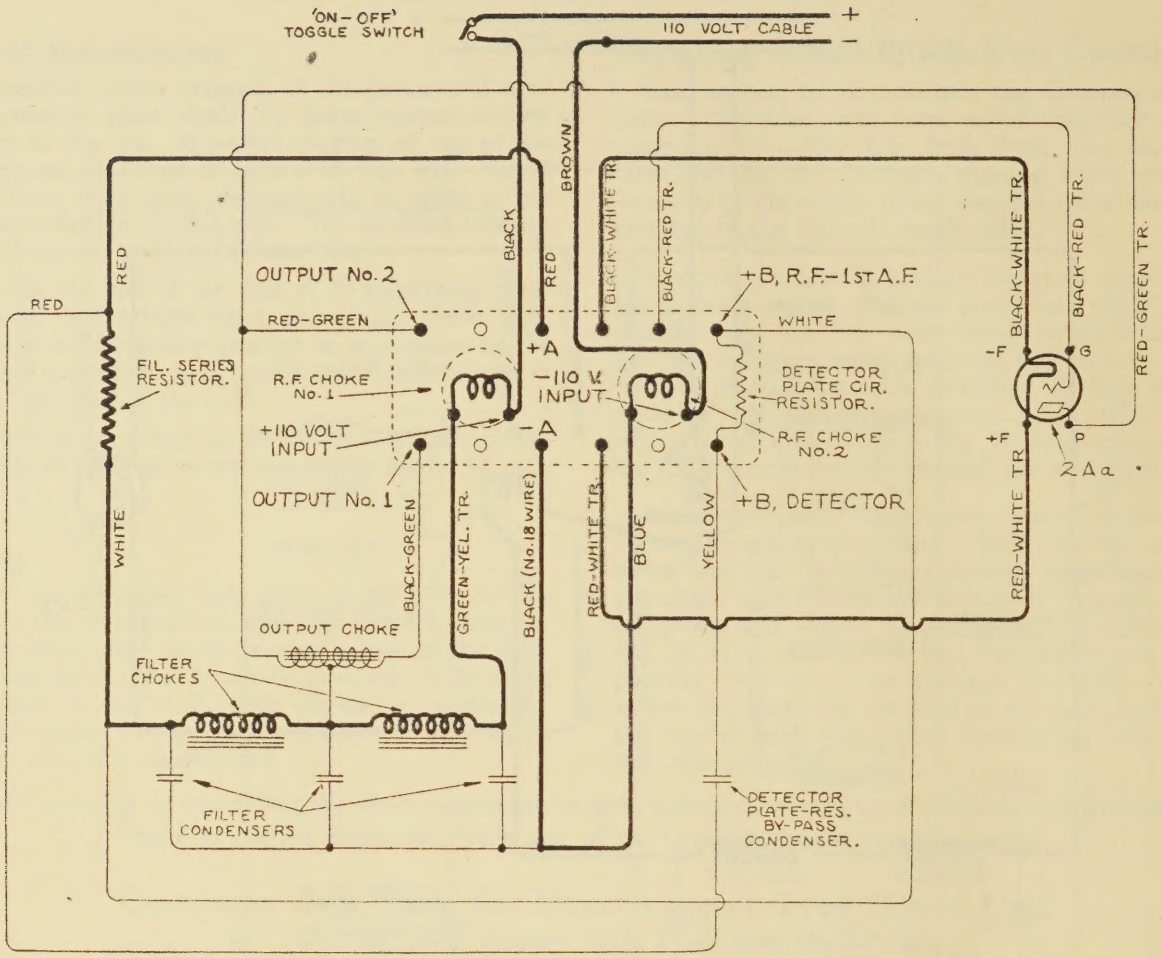


FIG. 103. WIRING DIAGRAM OF 1ST TYPE OF POWER UNIT FOR MODEL 41.

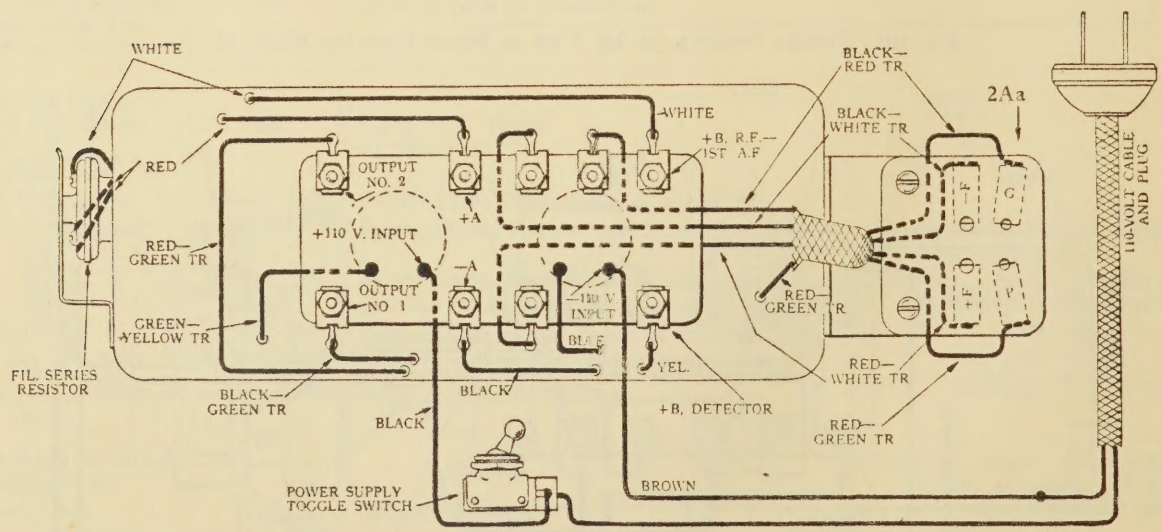


FIG. 104. SHOWING CONNECTIONS AND APPROXIMATE POSITION OF LEADS FROM SEALED CONTAINER IN 1ST TYPE OF POWER UNIT.

NOTE.—Complete direct current power units of the 1st, 2nd and 3rd type are interchangable in Model 41 receiver. Only the 3rd type is supplied as replacement.